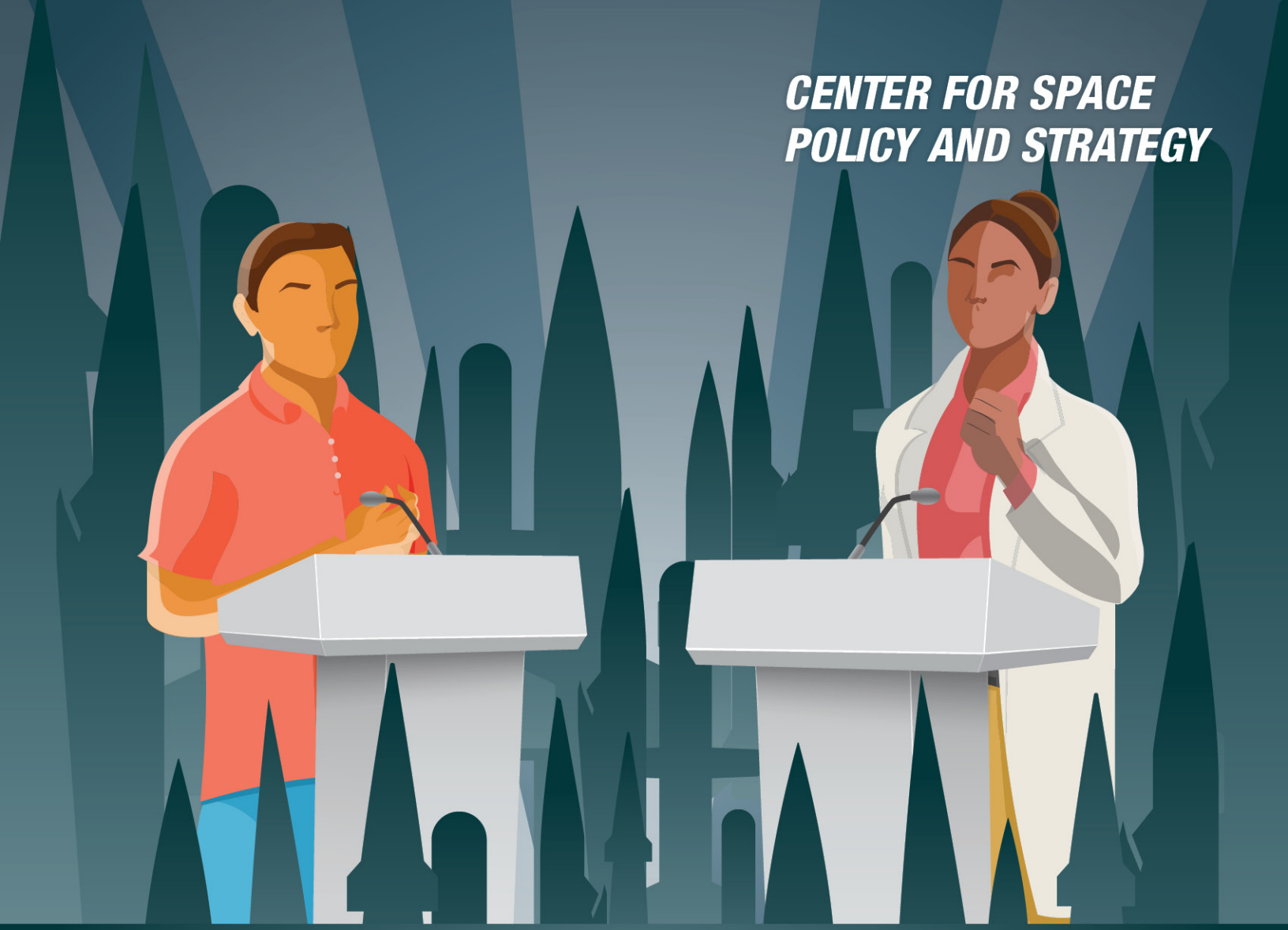

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THE HYPERSONIC MISSILE DEBATE

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Summary

The debate about how to respond to Russian and Chinese hypersonic missiles is difficult to navigate. Much of the attention centers on differing technological assessments of the missiles—some say the weapons are invincible, and some say they are a gimmick. But these different technological assessments are not actually driving the debate. Based on a series of interviews and literature review, this paper shows that experts' strategic objectives vis-a-vis Russia and China are fundamental to understanding their positions on hypersonic weapons.

This paper places views of hypersonics on a spectrum of strategic aims. It identifies four leading approaches:

1. ***Get Ahead*** **believes the United States should use hypersonics to achieve strategic advantages over Russia and China.**
2. ***Shields Up*** **calls for investing in new defenses to blunt attacks Russia and China might launch against the United States.**
3. ***Draw the Line*** **seeks to defend only against conventional attack, fearing that hypersonics might blur the divide (line) between nuclear- and conventional-armed missiles.**
4. ***Avoid the Race*** **sees hypersonics as overblown and the competition between the United States and Russia and China as avoidable.**

These approaches show that experts' technological and strategic views are often aligned in support of or in opposition to acquiring hypersonic missiles: experts who believe the technology will be crucial for future war tend to also believe that the United States finds itself in an unavoidable strategic military competition with Russia and China; experts who are more skeptical of the technology tend to also believe that strategic military competition with Russia and China is unnecessary. Moving from *Get Ahead* to *Avoid the Race*, proponents progressively become more skeptical of the technology and less willing to engage in strategic military competition—less interested in acquiring hypersonic missiles from both a technological and a strategic perspective.

Some experts have views on hypersonics in which their technological assessments are disconnected from their preferred strategic objectives; however, even in these cases, their strategic objectives help shape their perspectives on deployment and investment for the weapons. For defenses against hypersonic weapons, the story is similar—strategic aims are integral to the debate.

Views on hypersonic weapons are shaped by beliefs over whether we should be trying to win an arms race or avoid an arms race, whether to pressure Russia and China or reassure them, and whether mutual vulnerability with Russia or China is desirable or undesirable. These strategic assumptions are often hidden in arguments over the technological merit of the weapons. By clarifying the relationship between the technological and the strategic, this paper seeks to improve understanding of the policy debate about hypersonic missiles.

Introduction

The discourse on hypersonic missiles swings easily into extremes. A quick search of headlines yields the descriptors "unstoppable," "blindingly fast," "invincible," "nuclear nightmare" but also "ballyhooed," "gimmick," "overrated," and "hype."[1,2,3,4,5,6,7] These missiles have been likened to the introduction of the longbow at the Battle of Agincourt in 1415 and dismissed as just another purported missile gap.[8,9]

Even the terms *hypersonic missiles* or *hypersonics*, which commonly refer to glide vehicles or scramjet-powered cruise missiles, add to the confusion. Although "hypersonic" refers to speed (something that travels at least five times the speed of sound), it is the weapons' maneuverability, rather than their speed, that distinguishes them from missiles that follow ballistic trajectories. Even though these labels can be misleading, this paper adopts the terms as commonly used.[10,11]

Much of the attention on hypersonics centers on competing Russian and Chinese programs. Russia has fielded a nuclear-armed hypersonic glide vehicle called Avangard with the range to reach the continental United States from silos in Russia and is a developing a submarine-launched hypersonic missile called Tsirkon. China has also tested multiple hypersonic glide vehicles.[12,13] On October 1, 2019, Chinese President Xi Jinping unveiled the medium-range DF-17 hypersonic missile at a major military parade in Beijing.[14] According to testimony from U.S. military leadership, China is also pursuing an Avangard-like intercontinental range hypersonic glider.[15]

The United States itself has invested in offensive hypersonic missiles as well as missile defense capabilities designed to stop hypersonic systems. For hypersonic weapons and related research, the Department of Defense requested about $2.9 billion in fiscal year 2021 and $2.5 billion in fiscal year 2020.[16] For hypersonic defense, the department requested about $206.8 million in fiscal year 2021 and $157.4 million in fiscal year 2020.[17]

As these investments are being made, radically different perceptions persist over how hypersonics change the threat and how useful they are to the United States. These views are shaped by how much confidence we place in the technology of hypersonic missile systems and defense capabilities aimed against them. They are shaped by whether we are trying to win an arms race or avoid an arms race, whether we are seeking to pressure Russia or China, or whether we are seeking to reassure Russia and China. Experts vary in their understanding of what prompted these two competitors to develop their hypersonic missiles. They draw different lessons from the Cold War. These different takes drive divergent strategic aims that hypersonic missiles can contribute to or undermine.

This paper aims to demystify this complex debate. It shows that the different technological assessments of hypersonic missiles—"invincible" on one side, "gimmick" on the other—are actually not driving the debate surrounding the weapons. With some exceptions, people's technological views of hypersonics correlate with their strategic aims and their military objectives vis-à-vis Russia and China: Experts who believe the technology will be crucial for future war tend to also believe that the United States finds itself in an unavoidable strategic military competition with Russia and China; experts who are more skeptical of the technology tend to also believe that strategic military competition with Russia and China is unnecessary, the existence of which is, in part, our own doing. The paper shows that, for the most part, views on how to respond to Russian and Chinese hypersonic missiles are inextricably linked with views on what these strategic aims should be.

Organization of Paper

This paper proceeds in three sections. Section 1, "Hypersonic Competition," discusses leading approaches for how to respond to Russian and Chinese hypersonic missile developments situated on a spectrum of strategic aims, stretching from *outcompeting* on one end to *dampening the competition* on the other. In considering both offensive and defensive approaches for responding to Russian and Chinese hypersonic missile developments, it covers a range of expert arguments.

Although the leading approaches in the hypersonic competition section reflect most of the debate surrounding hypersonic missiles, they miss some approaches and rationales. The second and third sections unpack the offensive and defensive systems from one another—delving deeper into specific rationales—and capture perspectives that do not fit neatly in the first section.

Characterization of Approaches

The descriptions of the four approaches are based on a review of writing on hypersonics and interviews with leading experts on missile technology, missile defense, and strategic policy. The paper includes statements attributed to individuals that support the different categories. The use of these statements in connection with an approach does not suggest that the attributed person fits perfectly or agrees with the category because they are also partly built on approximations and deduction. As such, the paper should be read less as specific evidence that person X belongs in category Y but rather as a framework to navigate the broader debate.

Section 2, "Offense," discusses arguments surrounding offensive applications for hypersonic missiles. It lays out the two primary factors for gauging the levels of hypersonic missiles a person might support: (1) their confidence in the technology—the role of hypersonic missiles in future conflict—and (2) their view of whether we should be preparing for a high-intensity conflict on the Russian or Chinese mainland. These two factors help inform the decision to deploy a large arsenal of hypersonic missiles, a small capability of systems, or no hypersonics at all. This section shows that even in cases in which observers' preferred strategic aims are detached from their technological assessments, the strategic aims are fundamental for understanding their complete view on hypersonic missiles.

The Section 3, "Hypersonic Defense," covers arguments surrounding missile defense approaches to hypersonic missiles, focusing on the who and the where: who are we defending against and where are we defending. By addressing arguments focused on potential adversaries other than Russia and China and arguments focused on theater defenses rather than simply strategic homeland defenses, it covers more breadth than the hypersonic competition section can of the debate surrounding hypersonic defense. Much like the case with offensive systems, this section shows an alignment between technological assessments of missile defense and strategic objectives.

This paper does not judge which approach is the right one. Rather, it lays out the logic each approach provides and how they relate. It presents and analyzes the approaches without advocating for one of them.

Section 1: Hypersonic Competition

Figure 1 captures the leading arguments for and against hypersonics by putting them in the context of opinions about how the United States should respond to Russia and China. It proposes four principal approaches for responding to Russian and Chinese hypersonic missile developments situated on a spectrum of strategic aims. On the right end, the United States aims to outcompete Russia and China strategically in hypersonics; on the left end, the United States aims to dampen the missile and missile defense competition with Russia and China.

The four approaches are (from right to left):

1. ***Get Ahead.*** The United States should seek to lead in offensive hypersonics capability and use hypersonics to achieve strategic advantages over Russia and China.

2. ***Shields Up.*** The United States should invest in new capabilities to track adversarial missiles (conventional and nuclear) during their flight and intercept them before they reach their target.

3. ***Draw the Line.*** This approach emphasizes defense against conventionally armed hypersonics, drawing the line between conventional and nuclear hypersonic weapons.

4. ***Avoid the Race.*** The United States should rely on nuclear deterrence to address hypersonic threats and avoid a costly action-reaction cycle.

As shown in Figure 1, these approaches occupy areas on the spectrum with overlapping edges. A proponent of acquiring large numbers of hypersonic missiles (*Get Ahead*) may also support defenses against hypersonic missiles (*Shields Up*). In this case, due to resource constraints, the expert could prioritize the offensive or defensive investments or pursue a more limited portfolio of both (thus, situated in the overlap between the two). The approaches are not purely discrete, nor are they homogenous; rather, they are simplified ways to represent areas on a continuous spectrum.

These are not the only four approaches on the spectrum. The spectrum extends beyond these four

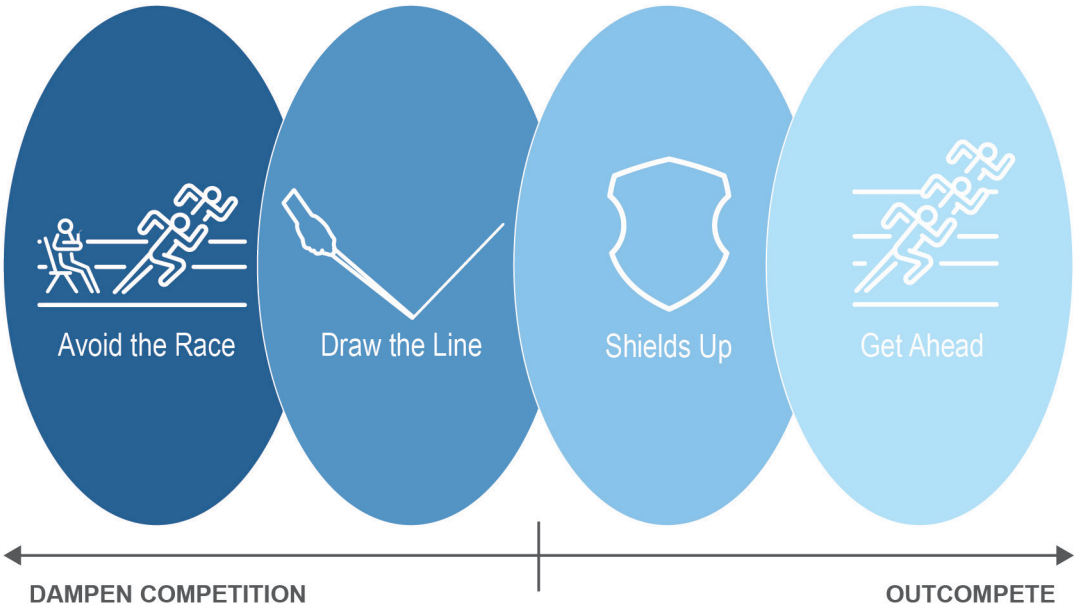

Figure 1: Hypersonic competition model.

in both directions. Neither *Get Ahead* nor *Avoid the Race* reflects the logical extremes of the divergent strategic aims. On the left, you could keep moving past *Avoid the Race* to a perspective advocating unilateral disarmament. The United States no longer having strategic arms would represent the logical extreme of the United States not engaging in a competition over such arms. On the right, you could move further than *Get Ahead* to an argument for striking Russia and China now or doing whatever is necessary to defeat them as soon as possible. Destroying your competitors would be the logical extreme of outcompeting. The four approaches discussed below represent those in the mainstream.

The central break is over whether seeking an advantage afforded from hypersonics is desirable or undesirable, responsible or reckless. This reflects the underlying point of Figure 1: How one sees hypersonics depends on how one views the competition with Russia and China. Is the competition a strategic one, a nuclear one, a competition that could easily accelerate into a major conflict on Russian and Chinese soil, one that requires the United States to seek military advantages and mitigate Russian and Chinese advantages? Or is it more of a peripheral, indirect competition that will not manifest itself in a more serious crisis unless the United States takes steps that create unnecessary anxiety in Russia and China, spurring action-reaction cycles that could make the security environment more precarious and less tenable? On the right side of the spectrum, gaining advantages with hypersonic weapons or mitigating the advantages of Russian and Chinese hypersonic weapons is viewed as necessary and crucial. On the left side of the spectrum, these actions are seen as needless and dangerous.

Get Ahead

The first approach, *Get Ahead*, calls for the United States to become the leader in hypersonic missiles. It views the three countries' pursuit of these missiles as a crucial weapons race, the winner of which will have "daunting military advantages."[18] Matthew Kroenig of the Atlantic Council has called for the United States to lead in this technology.[19] In an op-ed about hypersonic missiles, retired General David Deptula argued for the United States to "possess the capability and capacity to project overwhelming, decisive power."[20] Dean Wilkening at Johns Hopkins University Applied Physics Laboratory has made a case for the United States to pursue an inventory of "many hundreds, if not several thousand, hypersonic weapons."[21] "Winning the hypersonic race is a national imperative," according to the approach.[22]

The organizing principle of *Get Ahead* is that by becoming the leader in hypersonic missiles, the United States can achieve a strategic advantage over Russia and China. Such an advantage, according to the approach, would offer warfighting and deterrence benefits: It could prove decisive in a war with these rivals, and it could prevent a conflict because Russia and China would know they could not win. "If Russia and China feel outgunned by our hypersonics, I think the more logical response—and backed up by 70 years of history—is that they will become more cautious, not more aggressive, in crises," said Matthew Kroenig.[23] Gaining a technological or numerical edge would not only ensure the United States would be able to counter any action Russia or China take with a comparable action, but it could effectively coerce Russia and China. With such an advantage, the United States

could dissuade Russia and China from taking aggressive steps that could initiate a conflict, such as a sudden assault in pursuit of a fait accompli.

This high interest in strategic competition is matched by the approach's high confidence in hypersonic missile technology. The approach sees hypersonic missiles as means to achieve the strategic advantages it seeks. The missiles are "phenomenally accurate" and may "be so difficult to intercept that they may usher in an era of offence dominance in conventional strike warfare."[24,25] Their progression "could be part of a revolution in military affairs that happens every several decades or so."[26] Their potential to disrupt military affairs has been likened to stealth and precision weapons, machine guns, fighter jets, and nuclear weapons.[27,28]

Place on Spectrum for Get Ahead

Get Ahead anchors the right end of the spectrum operationalizing the strategic aim to *outcompete.* In traditional terms, it is the most hawkish of the approaches presented.

An advocate of a different approach might argue that our developing large numbers of hypersonic missiles would provoke Russia and China to pursue more threatening military capabilities than they would otherwise, thereby weakening U.S. security. *Get Ahead* rejects this logic: Russia and China are seeking to gain a strategic advantage over the United States; therefore, the United States hesitating to acquire new weapons will not result in Russia or China hesitating. This ties into why these countries developed hypersonic missiles in the first place. When asked what prompted Russia to develop hypersonic missiles, Mark Schneider of the National Institute for Public Policy responded simply, "To win."[29] They know "our missile defenses are not a threat to their existing strategic systems"; instead, they want these systems "because they want the edge in a conflict."[30]

More fundamentally, *Get Ahead* is deliberately seeking to pressure Russia and China to make them less comfortable.[31] The approach intends to make Russia and China more vulnerable: Hypersonic missiles could be used to target Russian and Chinese stationary and mobile missiles, command and control centers, sensor and radar sites—the very locations that Russian and Chinese leaders would be most concerned with protecting. An op-ed arguing for nuclear-armed hypersonic missiles states, "to deter, [the United States] needs to ensure that its arsenal is fit for purpose" to defeat an adversary in a regional war.[32] Only when Russia and China know they cannot win a conflict against the United States, according to the approach, will they be dissuaded from precipitating such a conflict.

Get Ahead, similar to all of the approaches, is not purely uniform. Across the approach, advocates support hypersonic missiles for targets in Russia and China's mainland to ensure that the United States can win a major conventional conflict. On the right side, proponents go further, seeing Russian and Chinese nuclear systems as tempting targets for U.S. hypersonic missiles. These proponents do not consider concepts like the nuclear stalemate, mutual assured destruction, or mutual vulnerability—which say stability results from opponents realizing that no one could hope to attack the other successfully without suffering comparable damage—as desirable or inevitable. Said Matthew Kroenig:

> For some people who have written on this, they have the mutual vulnerability and mutually assured destruction model in mind between the United States and Russia and China and therefore, anything that reinforces that mutual vulnerability is stabilizing and anything that could undermine it could be destabilizing. My view is that it really depends on who possesses the technology. If the United

> States and its democratic allies at the core of the international system are the leaders with this technology, it is much more likely that it reinforces existing power balances and existing sources of stability.[33]

According to this area of the spectrum, hypersonic missiles—coupled with other emerging technologies, including defenses—could be part of a new technological era that could upend these traditional notions of stability among the major powers.[34,35] Rebeccah Heinrichs of the Hudson Institute said that we should pursue hypersonic missiles "for counterforce targets in Russia and China, to include their strategic systems," adding that it is "foolish to exclude strategic systems, such as mobile nuclear-armed capabilities, from conventional strike targeting based on outdated notions of strategic stability."[36] *Get Ahead* views hypersonic weapons as tools for defeating Russia and China in a conventional conflict and potentially in a nuclear conflict by disarming or limiting the damage those potential adversaries can inflict.

If you believe that hypersonic missiles will be critical to future war and that we should seek to attain strategic advantages over Russia and China—that the U.S. having world-leading hypersonic capabilities could effectively dissuade these countries from initiating a conflict, from being aggressive in moments of crisis—you might advocate for *Get Ahead*.

Shields Up

The second approach, *Shields Up*, represents a classic missile defense approach, treating hypersonic missiles—both conventional and nuclear-armed—as a new missile defense challenge. It views the competition as between adversarial hypersonic weapons and U.S. defenses. While not as sanguine about hypersonic missile technology as *Get Ahead*, *Shields Up* is still confident in the technology, emphasizing that the missiles' evasive characteristics (their speed, trajectory, and maneuverability) pose serious problems for current U.S. homeland missile defenses. (Theater defenses are discussed in the third section.) Because the missiles can maneuver for most of their range and can travel at comparatively low altitudes, they can avoid or evade our current radar architecture, potentially impeding the ability of the United States to track and defend against them.[37]

To lessen the potential advantages of Russian and Chinese hypersonic missiles, the approach advocates for acquiring new missile-tracking capabilities, such as space-based sensors, and new and better missile intercept systems, shifting "more of its funding to defense programs focused on tracking and countering hypersonic missile attacks."[38] New space-based sensors "to detect and defend against hypersonic weapons threats" is "one way in which the U.S. can try to close the gap that currently exists with its adversaries."[39] Patty-Jane Geller at the Heritage Foundation recommended: "We need to develop a space-based sensor layer in the short-term and hypersonic defenses in the long-term. Our defenses will complicate their decision-making, which gives the United States more control over the conflict."[40] Just in 2020, several experts published op-eds calling for a space-sensor layer of satellites in response to hypersonic missiles, some also advocating for hypersonic intercept capabilities; going further back, these capabilities have been discussed for several years.[41,42,43]

Place on Spectrum for Shields Up

Like *Get Ahead*, *Shields Up*, which sits on the right side of the spectrum, sees our acquiring specific capabilities as a way of gaining some advantage in an inexorable military competition: Our acquiring robust missile defense capabilities helps us outcompete. The approach overall supports procuring some level of new tracking and intercept systems, but the capabilities and capacities envisioned are much more ambitious on the right side of the approach than on the left.

Similar to elements in *Get Ahead*, the right edge of *Shields Up* questions the value of concepts like mutual vulnerability and mutual assured destruction. Also, *Shields Up* sees missile defense, including hypersonic defenses, as a way to weaken, if not escape, these concepts.[44] A critic of this approach might argue that pursuing enhanced defenses against strategic systems would incite Russia and China without actually protecting the United States—even additional formidable defenses may not be able to prevent a missile attack wreaking unacceptable damage. The right side of *Shields Up* would respond that hypersonic defenses, perhaps in addition to other defenses, do not need to nullify the threat posed by strategic nuclear systems as long as they raise doubts in an adversary of whether a particular attack will be successful. To raise these doubts—"to have enough capability they are not confident that they can hurt us or our allies"—would discourage the adversary from initiating a strike.[45] Moreover, in case of war, more and better defenses could limit the damage inflicted. Said Peter Huessy of the Air Force Association, "If you have enough interceptors, the adversary may get a couple of missiles in, but you blunt the attack and you are not going to be intimidated to stand down."[46] The right side of *Shields Up* supports an extremely robust missile defense architecture that could defeat scores of missiles; not having these capabilities invites aggression, having them offers a strategic advantage.[47]

The right edge of *Shields Up* is also marked by a belief in left-of-launch missile attack operations as part of missile defense. The idea is that attacking an adversary's missiles before they launch can help defeat the overall missile attack, creating an offensive element to a nominally defensive approach.[48,49,50] The overlap between *Shields Up* and *Get Ahead* reflects interest in a mix of hypersonic missiles and hypersonic defenses. While some *Shields Up* proponents may also support the right end of the *Get Ahead* spectrum-level investment in offensive hypersonics, the practical reality of human and financial resource constraints means that it would be difficult to pursue maximum effort on both the offensive and defensive side simultaneously.

On the left side of *Shields Up*, advocates focus on more modest and localized defenses against hypersonic missiles. These narrower defenses cover critical locations, such as U.S. leadership sites and nuclear command, control, and communications (NC3) capabilities. On this area of the spectrum, *Shields Up* starts to overlap with the adjacent approach, *Draw the Line*, discussed in the subsequent section. An official in the Department of Defense proposed a scenario that reflects interest for some level of hypersonic missile tracking and localized defenses:

> Let's say we detect 10 intercontinental ballistic missiles and they are going after U.S. air force bases. The President has some idea of what is going on here. If, in contrast, you say to the President, "Mr. President, we saw 10 boosts—we think those were hypersonic glide vehicles—and we won't know where they are going in the United States until about 90 seconds before impact, maybe less." The President won't know what is going on. They might be attacking something in the middle of nowhere with nuclear weapons, they could be going after critical NC3 nodes, they could be coming to kill the President in Washington, DC, or [U.S. Strategic Command]. Such an attack could inhibit our ability to respond.[51]

On this area of the spectrum, we may remain vulnerable to Russian and Chinese missiles, including hypersonics, but we need to protect certain locations to ensure our nuclear deterrent is not undermined.[52]

If you believe that we should and can seek to defend the homeland against Russian and Chinese missiles,

even if hypersonic, then you might advocate for *Shields Up*.

Draw the Line

Whereas *Shields Up* is concerned with conventional and nuclear-armed hypersonic missiles, the third approach, *Draw the Line*, believes the impact of nuclear-armed hypersonic missiles is overstated. It argues that hypersonic weapons do not alter the nuclear threat because other existing Russian and Chinese nuclear-armed missiles can already effectively strike the United States, including our leadership and command and control nodes. Whether or not U.S. missile defenses can defeat Russian and Chinese nuclear-armed hypersonic missiles matters little, according to the approach, because other Russian and Chinese nuclear-armed missiles can already defeat U.S. missile defenses.

Instead, it is concerned with conventionally armed hypersonic missiles, which, if employed against critical nodes, could undermine the U.S. nuclear deterrent or impose enormous costs without having to cross the nuclear threshold. Like *Shields Up*, *Draw the Line* notes some of the characteristics of hypersonic missiles—including their speed, trajectory, and maneuverability—could present daunting challenges to U.S. homeland missile defenses. Russia and China could pursue conventionally armed hypersonic missiles that could threaten the United States, as noted by James Acton of the Carnegie Endowment for International Peace: "Over time, China will probably develop accurate, conventionally armed gliders capable of reaching ever deeper into the United States itself."[53] Conventionally armed hypersonic threats to the homeland, including on "NC3 systems, satellite-uplinks and down-links," is the area where hypersonics could make "the biggest difference" and constitute "a serious non-nuclear threat to the United States," including potentially to the "American second-strike capability."[54,55,56]

In response, *Draw the Line* argues that we should harden critical leadership and command and control nodes against strictly conventional attack. This would entail predominantly passive defenses, like diversifying and "hardening and burying critical systems."[57] These steps would help ensure the United States has a "functioning command and control system" that is not "vulnerable to the weak node threat" and that we "preserve continuity of operations of national command authority, not having to use or lose our systems," as noted by former White House official Jon Wolfsthal.[58] By hardening critical leadership and command and control nodes against conventional attack, such as those in Washington and in Omaha (the location of U.S. Strategic Command), we can continue to operate in the wake of a limited strike scenario. That way, Russia and China know that they can only hurt us strategically if they launch a nuclear strike on us, one that could precipitate a nuclear strike in return. The approach relies heavily on nuclear deterrence—the idea that one country would be deterred from using nuclear weapons as long as it would suffer destruction from nuclear weapons as a consequence. By preventing an adversary from being able to achieve a strategic effect with conventional weapons, the approach seeks to keep the distinction between conventional and nuclear stark to "draw the line" between conventional and nuclear. While a nuclear strike will produce a strategic effect, a conventional strike will not. The defensive measures advocated in this approach would seek to protect against conventional attack, and the U.S. nuclear deterrent would seek to prevent a nuclear attack.

Place on Spectrum for Draw the Line

Draw the Line sits on the left side of the spectrum. As we move toward the left, we become more focused on dampening competition for missiles and missile defenses with Russia and China and less focused on trying to develop strategic advantages

over them. We may be in a competition with Russia and China, according to the approach, but it is heavily dampened by the same threat of nuclear retaliation that turned the Cold War into the Long Peace.

Proponents of approaches on the right side of the spectrum might criticize *Draw the Line* for the inadequacy of its proposed solutions. To these proponents, measures like hardening, diversification, and redundancy may seem insufficient for capabilities that present serious challenges for homeland defenses and focusing solely on conventional systems fails to account for the capabilities (nuclear) that can impose the most damage. For *Draw the Line*, the limitations of its solutions are deliberate. Unlike some elements in *Get Ahead* and *Shields Up*, *Draw the Line* embraces the nuclear stalemate as enforcing stability. According to this area on the spectrum, attempts by the United States to alter its vulnerability to Russian and Chinese nuclear forces (such as pursuing defenses with the purpose of defeating Russian and Chinese nuclear-armed missiles or pursuing offensive missiles that could target their nuclear-armed capabilities) are counterproductive. "Mutual vulnerability is a fact of life," said James Acton. "We target their nuclear deterrent at our own peril."[59] By taking actions that could undermine their nuclear deterrent, we simply prompt them to develop new and scarier weapons, which, according to the approach, perpetuates a needless action-reaction cycle of U.S. missile or missile defense investments and corresponding Russian and Chinese investments that still ends with our remaining vulnerable to their nuclear weapons. If we expand missile defenses, they develop weapons that can defeat those defenses. If we develop new defenses, they develop new weapons. So, the action-reaction cycle persists. By focusing on passive and limited active defenses in lieu of robust active missile defense and offensive missiles, *Draw the Line* aims to discourage Russia and China from

Arms Races and the Cold War

Perceptions on arms races reveal assumptions about strategic objectives. Some experts think of arms races as inherently bad, something that generates risk and pushes countries to the precipice of conflict. These experts may focus on trying to avoid an arms race or arrest one that is underway. This reflects views on the left side of the spectrum. Other experts do not perceive arms races as bad but rather as something that could be used to achieve technological prowess, innovation, and—most importantly—relative gains over the competitor nation. This comports with the idea of winning an arms race and reflects perspectives on the right side of the spectrum.

Along these lines, experts interviewed for this paper offered different lessons from the Cold War depending on which side of the spectrum they fell. Matthew Kroenig, on the right side, pointed to the Cold War as evidence that the United States will win in an arms race. "The Cold War is clear evidence that it is not a wise strategic decision to compete with the United States at the highest levels for strategic capabilities—that was a losing proposition in the Cold War. China has taken note of that." On the other side, Jon Wolfsthal cited the Cold War as evidence that arms races are inherently destabilizing: "I reject the idea that we can spend our way and develop our way to a position of security and superiority through either missile defenses or staying ahead of whatever niche capability the Russians or Chinese might develop. I think those are disproven, flawed, discredited concepts: that is how we ended up with 35,000 nuclear weapons in the Cold War that didn't bring any modicum of security that we are still paying an enormous financial and security price." These views support the broader argument that understanding differing mental models people use is critical to understanding the debate on hypersonic missiles.

continuing the action-reaction cycle—to dampen the competition—but it still sees hypersonics as new technological developments that might affect that underlying stability, putting it to the right of *Avoid the Race*.

The distinction between the left and right ends of this approach largely depends on the extent to which we should develop defensive measures against hypersonic missiles. The right side would achieve near impenetrable defenses, including active measures, though just in localized areas like the metropolitan areas of Washington and Omaha. The left side may not even use active defenses but rely on passive measures. The modest actions on the left end overlap with the fourth approach, *Avoid the Race*, discussed in the next section.

If you worry that conventional armed hypersonic missiles create new strategic risks but do not want to push Russia and China into a strategic arms competition, you might advocate for *Draw the Line*.

Avoid the Race

Whereas the first approach seeks to get ahead in terms of hypersonic missiles or defenses against hypersonic missiles, the fourth approach, *Avoid the Race*, seeks to prevent the competition altogether. As its name suggests, this approach advocates against arms racing the Russians and Chinese. It says that we should not let their hypersonic missile developments drive us into chasing expensive and illusive defensive capabilities or pursuing offensive systems that will offer us little beyond making Russia and China more anxious about their nuclear forces. Rather, we should trust nuclear deterrence to prevent major strategic conflict among the three countries.

A central tenet of *Avoid the Race* is that the strategic impact of Russian and Chinese hypersonic missiles is exaggerated. Advocates believe these systems will not play a major role in future conflict because the technology does not change the strategic calculus: These countries can already strike us with missiles other than hypersonic glide vehicles or hypersonic cruise missiles.[60,61] "My sense is that hypersonic missiles will have a negligible impact on future war," said Jeffrey Lewis of the Middlebury Institute of International Studies at Monterey. "It is not clear to me that hypersonic missiles will be more difficult than existing missiles for us to shoot down."[62] Cameron Tracy of the Union of Concerned Scientists writes: "These weapons will not reach the United States more quickly than existing missiles, will not strike without warning, and will not alter the fundamental balance between missile offense and defense."[63] Analysts in this area of the spectrum have questioned whether hypersonic glide vehicles are particularly accurate.[64,65] These assessments of the technology dramatically differ from the assessments in *Get Ahead*. Proponents of *Avoid the Race* have characterized some of the claims of hypersonic missiles as "overhyped" and "distorted."[66,67] Like *Get Ahead*, this approach aligns views of the strategic competition directly with views on the efficacy of hypersonics. *Avoid the Race* has little interest in strategic competition and sees little value in the technology.

Place on Spectrum for Avoid the Race

Avoid the Race falls on the left side of the spectrum; it is the most dovish of the approaches presented. More than any other approach, *Avoid the Race* focuses on dampening competition (stopping the action-reaction cycle noted in *Draw the Line*) and relying on nuclear deterrence.

Proponents on the right side of the spectrum would criticize this approach for failing to react to Russian and Chinese missile developments that they contend offer advantages that could alter the strategic relationship among the major powers. *Avoid the Race* disagrees with the assumptions implicit in the critique. According to this approach, hypersonic missiles do not represent a revolution in capability,

and, more importantly, we will never be able to alter the fundamental relationship among nuclear powers, nor should we want to. Said Jeffrey Lewis:

> The reality is that we are never going to have such an overwhelming advantage that we would ever be confident in initiating a nuclear war with Russia or China, or even North Korea, so I find people who cannot accept that curious. I cannot understand how people could ever think we would ever be at a point that you would be confident that you would not lose a single city to a country that does not have a trivial number of nuclear weapons. I am a person who thinks Paul Warnke was right when he compared the arms race to a treadmill and the only victory in that race is the first off the treadmill. So that ends up informing my sense that once we have a secure second-strike capability, I no longer care about the details.[68]

Avoid the Race argues that attempts to gain strategic advantages over Russia and China, by arms racing with hypersonics or investing in new homeland missile defenses, are not only futile but also "dangerous" and "increase the likelihood of conflict."[69,70] Along these lines, some experts pointed to Russia's Avangard program as a response to our withdrawing from the Anti-Ballistic Missile (ABM) Treaty: "The U.S. pulls out the ABM Treaty, Russia develops these systems to get around our missile defenses, we then develop these missiles because Russia has them, and now we are in a weird position where we all have a bunch of unnecessary weapons," said Cameron Tracy.[71] By pursuing systems, either offensive or defensive, that produce anxiety in Russia and China about their nuclear forces, we are spurring them to take new steps to ensure their survivability. Such steps could include their acquiring new capabilities or adopting new operational concepts that could have the ultimate effect of making conflict more likely, of making us less safe. In contrast, according to the approach, our refraining from threatening Russia and China strategically will give them less incentive to develop capabilities that threaten us strategically, thus avoiding costly investments and destabilizing arms races.

Absence of Arms Control

The idea of bilaterally or multilaterally restricting or banning hypersonic systems is not addressed in any of the four approaches. That is because arms control could span across the spectrum. On both sides of the spectrum, proponents could advocate for an arms control agreement if they believe it would support their strategic aims, as divergent as their strategic aims could be from one another. Although arms control advocates are more likely to be on the left end of Figure 1, a proponent of *Get Ahead* could support some version of arms control if the person believes that the specific arms control agreement limits Russia and China in some way to the advantage of the United States, which could help ensure the United States outcompetes Russia and China. Conversely, a proponent of *Avoid the Race* could support an arms control agreement if the person believes it reduces risk and dampens competition. Arms control is a tool that could be used for different purposes, the value of which could be distinct for different people.

As the approach moves left, advocates argue for going further than simply refraining from developing hypersonic missiles and hypersonic defenses. This includes placing greater restraints on our strategic capabilities to assure Russia and China that we are uninterested in a strategic or nuclear competition. In this vein, Eric Gomez of the Cato Institute has argued for eliminating U.S. homeland missile defenses:

> A more ambitious form of American restraint would be a complete divestment

> from homeland missile defense. Divestment would entail dismantling all [ground-based midcourse defense] interceptors, abandoning research and development on boost-phase defenses that engage enemy missiles as they begin flight, and forswearing interceptors in outer space. . . . Complete divestment from homeland missile defense would send a strong signal to other near-peer competitors that the United States does not wish to negate their nuclear arsenals. . . . Divestment from homeland missile defense would reinforce nuclear stability.[72]

The variance in *Avoid the Race* is largely driven by differences in what steps are necessary to stop the action-reaction cycle.

If you believe that the U.S. strategic relationship with Russia and China is stable—that even with Russian and Chinese hypersonic missile developments, a large-scale conflict is unlikely—you might advocate for *Avoid the Race*.

Relationship of Technology and Strategy for Hypersonic Competition

The spectrum displayed in Figure 1 shows a close linkage between technological views and strategic aims; i.e., both technological views and strategic aims push for or against developing a particular capability. On the right side of the spectrum, two governing assumptions are that (1) the United States should seek strategic military advantages over Russia and China and that (2) hypersonic missiles are critical for future war. This strategic view (assumption 1) and technological view (assumption 2) are aligned in that they both support acquiring hypersonic missiles. On the left side of the spectrum (*Avoid the Race*), the assumptions are the opposite: (1) the United States should be content with the strategic balance among the major powers and (2) hypersonic missiles will not be critical to future war. These assumptions also align strategic and technological views: both support not adopting hypersonic missiles. From left to right (*Avoid the Race* to *Get Ahead*), Figure 1 reflects a progression not only in the combativeness of the strategic aims but also in the importance of hypersonic missile technology. *Avoid the Race* believes the missiles' capabilities are exaggerated; *Shields Up* and *Draw the Line* believe they present a new missile defense challenge, and *Get Ahead* sees the missiles as transformational. This connection between technological views and strategic aims largely captures the discourse surrounding responses to Russian and Chinese hypersonic missile developments.

But it is not complete. As revealed in some of our interviews, a person's views on hypersonic missiles and hypersonic defenses could be disconnected from their preferred strategic aims. They may seek to dampen competition and still see hypersonics as game changers, or they could seek to outcompete but not think hypersonics change any calculus—hence the need for the offense and defense sections. These sections offer more, though, than simply capturing perspectives that do not align with Figure 1. By identifying the elements that can determine support for offensive and defensive systems, they provide more depth than Figure 1 can, getting us closer to explaining force structure positions.

Section 2: Offense

This section seeks to fill in the gaps of Figure 1 by capturing rationales in which the strategic and technological views on hypersonics are not aligned. These are rationales in which the technological view supports acquiring hypersonics but not the strategic view or in which the strategic view supports acquiring hypersonics but not the technological view.

A person could believe hypersonic missiles will be critical for future war but is also worried about the development of capabilities that could be highly escalatory in a crisis with Russia or China. That person may see value in the limited use of hypersonic missiles even if their strategic aims are more in the middle or on the left side of the spectrum. Jill Hruby, former director of Sandia National Laboratories, espoused a view along these lines. Her comments reflect support for hypersonic missiles because of their promise for future war, but she is not aiming to strategically outcompete Russia and China.

> My personal view is that this is a breakthrough in missile technology. I think a small number of these systems would be something we would want to pursue. If used, hypersonics could keep escalation under control by not creating significant collateral damage. For example, a terrorist cell in a country that we don't have ready access to could be a good target for hypersonic systems. These systems could be very interesting for future war. . . . We should not be developing hypersonic systems to overly provoke Russia or China. It should not be targeting their ability to respond or their command and control.[73]

The reverse of this rationale is also logical. A person could fall on the outcompete end of the spectrum but simply not see hypersonic missiles as a valuable technology, considering other alternatives and cost. This rationale would support pursuing strategic advantages over Russia and China but not view hypersonic missiles as the best way to attain those advantages. Said Tim Morrison, former White House staffer who is currently at Hudson Institute:

> I wouldn't pursue large numbers of hypersonic glide vehicles. That's not because I care about the overwrought concerns from the arms control community that these things cause instability or ambiguity—I think that's nonsense—and frankly, I want to find areas where we can achieve strategic advantages over Russia and China. But I would prefer to not invest treasure into chasing the Russian and Chinese hypersonics and would prefer instead to buy lots and lots of intermediate-range ballistic missiles and cruise missiles.[74]

Understanding Different Offense Positions

Each of these arguments can be mapped using two axes: (1) confidence in the technology's potential for future war and (2) interest in focusing on a major conflict against Russia and China that would include missile strikes on core capabilities in their mainland (this goes beyond having some form of nuclear deterrent).[75,76]

Treating each axis as a binary produces four positions:

1. Low confidence in the technology, low interest in focusing on major conflict.

2. Low confidence in technology, high interest in focusing on major conflict.

3. High confidence in technology, low interest in focusing on major conflict.

4. High confidence in technology, high interest in focusing on major conflict.

As reflected in Figure 2, these categories shed insight surrounding what levels of hypersonic missiles, if any, the United States should pursue. The dark blue boxes reflect the majority of the debate, as noted in Figure 1, and the light blue boxes reflect minority positions missed in Figure 1.

Focus on Major Conflict; Hypersonic Missiles Are Important

According to the view in the upper right box, hypersonic missiles could be ideal for hitting targets like adversary missiles, sensors, air defenses, and command and control centers in Russia or China. In a chapter published in October 2020, Dean Wilkening identified potential targets in mainland China for U.S. hypersonic weapons, including around 150 medium-range conventional ballistic missile transport erector launchers (TEL), 200 intermediate-range ballistic missile TELs, 100 medium-range ground-launched cruise missiles, 150 medium- and long-range special mission aircraft, and at least 192 long-range surface to air missiles.[77,78] This argument aligns with *Get Ahead*. Covering this breadth of critical targets demands large deployments of hypersonic missiles, as espoused under the approach, and procuring hypersonic missiles for these types of targets comports with the strategic aim to outcompete.[79]

Focus on Major Conflict; Hypersonic Missiles Are Not Important

The perspective in the upper left box matches the strategic aims of *Get Ahead* without the accompanying belief in the utility of hypersonic missiles to carry out such missions. This perspective believes that we could more effectively hold the same types of targets at risk with other types of missiles, due to other alternatives and cost tradeoffs.

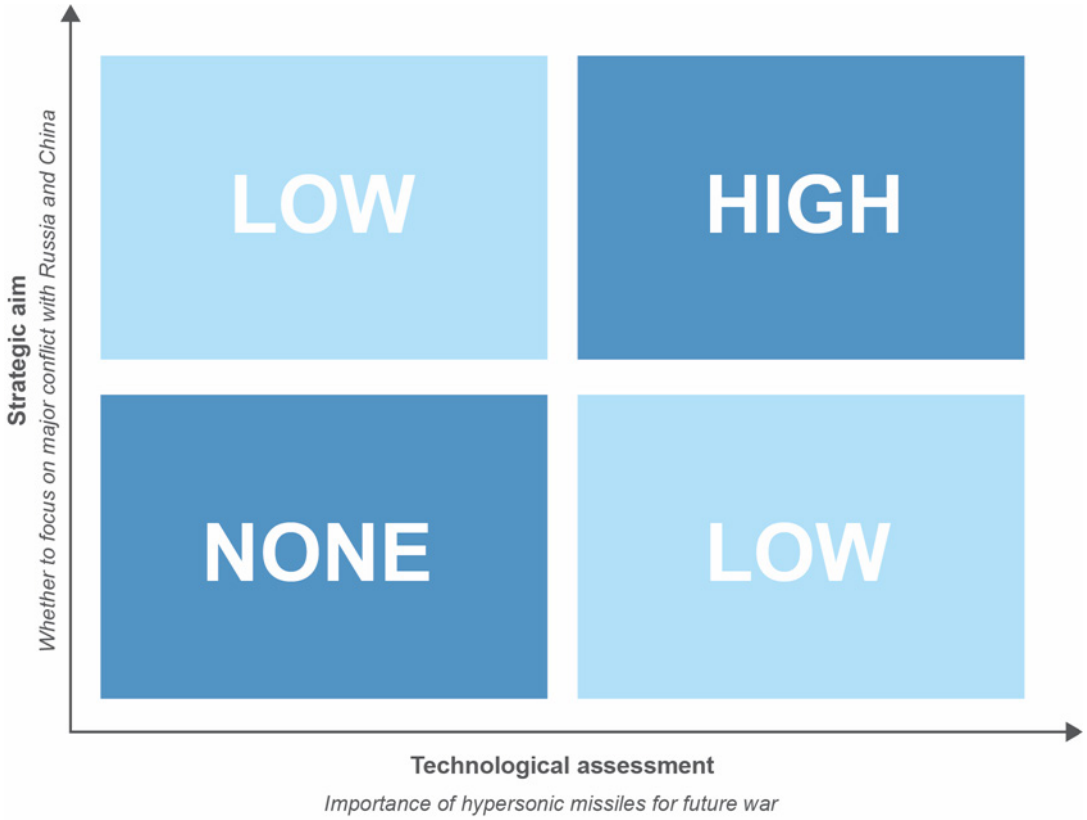

Figure 2: Hypersonic missiles: How much deployment?

However, because of its interest to outcompete, the perspective supports a small deployment of hypersonic missiles as technological hedge in the event the capabilities evolve such that they become more integral to wartime operations. This perspective is not captured in the spectrum of approaches described in Section 1, highlighting the need for this matrix.

Do Not Focus on Major Conflict; Hypersonic Missiles Are Not Important

The perspective in the lower left box aligns with *Avoid the Race*—that is, the military utility of hypersonic missiles is exaggerated, and we should refrain from acquiring capabilities that would create anxiety in Russia and China by giving the impression that we are attempting to undermine their nuclear deterrent. Cameron Tracy said that the weapons are "often slower than ballistic missiles," that they are "easy to detect," and that we shouldn't be "focusing on capabilities to target Russian and Chinese strategic sites."[80] Melissa Hanham of the One Earth Future Foundation said, "We should not develop new missiles to strike the Russian and Chinese mainland and if we were, hypersonic missiles would not necessarily be the ideal capability for that mission."[81] This perspective advocates for zero deployment of hypersonic missiles.

Do Not Focus on Major Conflict; Hypersonic Missiles Are Important

The view in the lower right box reflects a belief in hypersonic missiles as an important military capability worth pursuing and reluctance to target critical locations in Russia and China's mainland, which it perceives would be extremely provocative. Delineating experts' position for offense depends, in part, on the military missions for which they think hypersonic missiles would be ideally suited. Instead of arguing for deploying hypersonic missiles for targets like adversary missiles, sensors, and command and control centers, this perspective argues for hypersonic missiles exclusively for purposes other than hitting critical sites in Russia or China. Two examples of such missions that interviewees referenced were terrorist and high-value maritime targets.[82,83] This perspective calls for smaller deployments of hypersonic missiles than the upper left category because using hypersonic missiles for these purposes would require fewer missiles than missions to defeat Russian and Chinese strategic and conventional capabilities. As with its converse, this view is not explained by the spectrum of approaches discussed earlier in the Section 1.

Relationship of Technology and Strategy for Hypersonic Missiles

Debates over whether to pursue hypersonic missiles—and, if so, how many—often focus on distinctions in technological assessments, whether the capabilities will have an immense or overstated impact on future war.[84] But these technological assessments are only part of the equation: Experts' strategic perspectives are integral to understanding their broader views on hypersonic missiles. This section explains how some experts' strategic views and technological views do not jointly support or oppose hypersonic missiles. However, even in these cases, as shown in the 2x2 offense matrix, experts' strategic objectives vis-à-vis Russia and China affect the deployment levels they support. Moreover, these perspectives represent exceptions. Most arguments on hypersonic missiles can be characterized as the following: "Hypersonic missiles are critical to future military operations, and we need to outcompete Russia and China," or "Hypersonic missiles are overhyped, and trying to outcompete is destabilizing." For these arguments, the strategic and technological views are in direct alignment for or against acquiring hypersonic missiles.

Section 3: Hypersonic Defense

Similar to the offense section, this section, "Hypersonic Defense," offers more nuance on perspectives than Section 1. Just as *Get Ahead* assumes advocates of hypersonic missiles are seeking strategic advantages over Russia and China, so too does *Shields Up* assumes advocates of hypersonic defenses are seeking strategic advantages—that these capabilities will, at least in part, be protecting homeland locations against Russian and Chinese hypersonic missiles. Someone could, however, support hypersonic defenses for separate reasons.

Advocates of hypersonic defenses could deviate from the leading approaches in Figure 1 because they want such systems to defend (1) exclusively theater capabilities or (2) entirely against the threat posed by North Korea, Iran, or other adversaries (excluding Russia or China) acquiring hypersonic missiles. As such, experts could support hypersonic defense investments but may not fit neatly in the *Shields Up* approach.

These two variables—(1) where are we defending (theater, limited homeland, extensive homeland) and (2) who are we defending against (smaller potential adversaries like North Korea and Iran or competitor states Russia and China)—not only expose some of the gaps of the leading approaches in Section 1 but also give greater insights into views on missile defense force structures.

Understanding Positions on Defense

Figure 3 addresses three positions on missile defense:

1. Defenses Against Everything
2. North Korea and Iran Focus
3. Only Theater

These positions vary from one another by their strategic aims and technological assessments for missile defense. Strategically, they differ in whether they intend to—or at least are willing to—weaken the nuclear stalemate with Russia and China. Technologically, they differ in what they consider possible for missile defense: the ability of current or future homeland defenses to effectively defeat missile threats and the ability of theater defenses to defend against shorter-range missile threats. Unlike the approaches covered in the offense section—in which the strategic aims and technological assessments of hypersonic missiles aligned for two approaches and not for the other two approaches—each of the positions highlighted in this section contains strategic aims and technological views of defenses that are in concert with one another, just at different places on the spectrum.

Figure 3 shows each position's support for or opposition to:

- Theater defenses against smaller potential adversaries, like North Korea or Iran.
- Theater defenses against rivals Russia and China.
- Homeland defenses against smaller potential adversaries.
- Homeland defenses against rival states.

The blue boxes reflect support; white boxes reflect opposition. In addition to the three positions ("Defenses Against Everything," "North Korea and Iran Focus," and "Only Theater"), Figure 3 includes a chart in the lower right for other potential positions (namely, no missile defenses or theater defenses against North Korea and Iran only).

Defenses Against Everything

The "Defenses Against Everything" position subsumes all of the possibilities. It aligns closely with the right edge of *Shields Up*, advocating for homeland defenses and theater defenses against Russian and Chinese hypersonic missiles. This

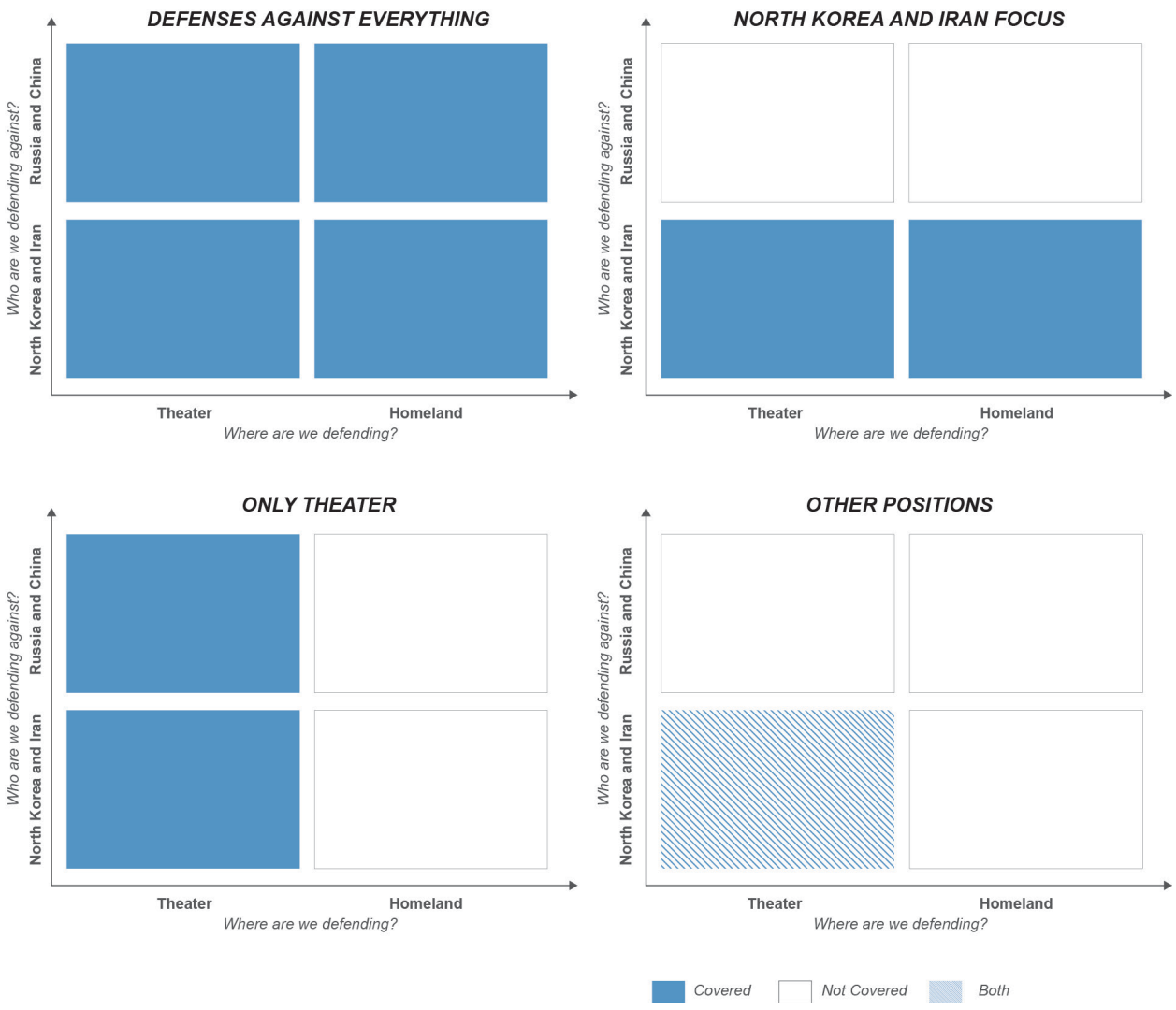

Figure 3: Missile defense positions.

comprehensive position can extend beyond simply hypersonic glide vehicles and hypersonic cruise missiles to other Russian and Chinese missiles, including other nuclear-armed capabilities.[85,86] Generally, proponents of robust homeland defenses also support robust theater defenses.[87]

For this position, both the strategic aims and technological assessments of missile defenses support expansive and robust defenses. Strategically, like the right edge of *Shields Up*, it seeks to weaken the stranglehold of concepts like mutual vulnerability and mutual assured destruction. Technologically, it believes in the possibility of missile defense to effectively defend theater locations and the homeland against missile systems not just of North Korea, Iran, and rogue actors, but also of Russia and China. The position is seeking to strategically outcompete Russia and China and has considerable belief in the potential of missile defense.

North Korea and Iran Focus

The "North Korea and Iran Focus" position says that we should prepare for the prospect that potential adversaries other than Russia or China, such as North Korea and Iran, acquire hypersonic missile capabilities. Although Russia and China are the only countries currently deploying hypersonic missiles, other countries could join the hypersonics game. A 2017 RAND Corporation report predicted that there was less than a decade available to substantially hinder the potential proliferation of hypersonic missiles and associated technologies.[88] Given that it could take several years to develop homeland hypersonic defenses, we should start developing these defenses now, advises this position, to prevent North Korea and Iran from threatening us in ways that we find unacceptable.[89]

Strategically and technologically, the "North Korea and Iran Focus" position represents a milder version of "Defenses Against Everything." Deploying homeland defenses against North Korean and Iranian missiles reflects a technological belief that homeland defenses can effectively blunt a hypersonic missile strike from a limited adversary but not against a strike from major powers like Russia and China. Strategically, the position is not focused on Russia and China, but it is willing to make Russia and China more uncomfortable—Russia and China may not be convinced that our defenses are not actually about them. Although this position is not seeking to undermine the nuclear stalemate with Russia and China, it is willing to accept the tradeoff that protection against future North Korean and Iranian hypersonic missiles is worth pursuing even if doing so leads Russia and China to worry more about the efficacy of their missiles. Thus, it reflects a middle course between deliberately aiming to weaken strategic stability and avoiding actions that could be perceived as undermining that stability.

Only Theater

The "Only Theater" position argues for theater defenses to hypersonic missiles against all potential adversaries but no homeland defenses against hypersonic missiles. Because theater defenses would not undermine Russia's and China's nuclear deterrent, advocates of the approaches on the left side of the spectrum described earlier in Section 1 could support theater defenses while still aspiring to dampen the nuclear or strategic competition.[90,91]

Strategically and technologically, this position falls on the left side of the spectrum. Technologically, it believes that although theater defenses can be effective, homeland defenses are not. Strategically, the position sees theater defenses as valuable for regional competition with Russia and China but homeland defense investments as means to threaten strategic stability, creating a more dangerous dynamic among the major powers. Laura Grego from the Union of Concerned Scientists captured this perspective; regarding homeland defenses (technologically), she said, "What we have learned from homeland defense investments is that they cost a lot and produce little. From a technical perspective, homeland missile defense is just really hard." Regarding homeland defenses (strategically), she said, "Plus, [homeland missile defense] investments can counterintuitively make the U.S. more vulnerable. Despite their limited effectiveness, adversaries worry they will eventually work and so develop new nuclear delivery systems pointed at us." Regarding theater defenses (both technologically and strategically), she said, "Theater defenses don't generally generate the same anxiety for adversaries [as homeland defenses]. They cost less and defenses against theater-range missiles have been shown to be more effective in tests."[92] We are in a regional competition with Russia and China, according to this position, which

necessitates regional missile defenses, but we must avoid a strategic competition.

Other Positions

Using the x and y axes, other potential positions exist, although it is hard to find experts who subscribe to them. Someone could advocate for no missile defenses, even at a theater level, believing missile defense does not work and that we should not engage in a missile-missile defense action-reaction cycle with Russia and China, even a regional one. Someone could also argue for strictly theater defenses against North Korea and Iran, also believing that we should not engage in a theater or strategic competition with Russia and China but having some confidence in theater missile defenses to defend against missile threats from more limited actors.

Relationship of Strategy and Technology for Hypersonic Missile Defense

Similar to views on hypersonic missiles, strategic objectives and views on the technological possibilities of missile defense are heavily aligned for or against acquiring defenses. Moving from "Defenses Against Everything" to "North Korea and Iran Focus" to "Only Theater," we become more skeptical of the technological possibilities of missile defenses and less interested in strategic competition.

In exploring rationales for theater defenses, this section parses out the strategic from the non-strategic in a way that the other sections do not. The spectrum in Section 1 is focused on strategic responses to Russian and Chinese hypersonic weapons; as such, the two approaches focused on defenses—*Shields Up* and *Draw the Line*—deal with strategic (homeland) defenses rather than theater defenses. Strategic implications are also interwoven in Section 2, "Offense," because hypersonic missiles could be used for strategic or non-strategic ends (e.g., targeting Russian and Chinese nuclear-armed missiles and command and control nodes would be strategic, whereas targeting Russian and Chinese oil tankers would not be). With defenses, at least with land- or sea-based systems, that is not the case. Deploying theater defenses to protect U.S. maritime assets or forward-deployed bases, for example, would be strictly non-strategic: it would not directly weaken Russia and China's nuclear deterrent.

One trend in the interviews and literature review was the breadth of support—or at least consideration of support—for theater defenses against hypersonic weapons. Although there was little consensus on which capabilities or concepts would be necessary to achieve theater defenses (for example, adapted terminal interceptors, new hypersonic intercept systems, boost-phase missile defense, space-based sensors, etc.), most of the interviewees supported the idea of protecting some theater locations.[93,94] This widespread support was in stark contrast with strategic defense, which was very contested. Experts' widespread support for some form of theater defenses, regardless of which of the leading approaches they most closely fell into, and their widespread disagreement about strategic defenses is yet more evidence that most of the debate about hypersonic missiles, and our responses to them, reflects differences in strategic perspectives and differences in strategic aims.

Conclusion

The debate about hypersonic missiles is frequently characterized as a technological one, but it is much more nuanced than that. Although exceptions exist, as covered in sections 2 and 3, most views of hypersonics are inextricably linked to how observers see our strategic objectives vis-à-vis Russia and China. This should not be too surprising. Put generically, the four approaches in the spectrum reflect typical reactions to any widget with serious military potential: exploit the technology against potential adversaries to gain an advantage (as in *Get Ahead*), focus on counter-capabilities to nullify or lessen the advantage an adversary seeks with the technology (as in *Shields Up* and *Draw the Line*), or sidestep the technology and counter-capabilities because of a belief that any advantage afforded by the technology is not worthwhile (as in *Avoid the Race*). Do we want the advantage? Do we want to mitigate others' advantage? Or, do we want neither? What are our desired ends? The merit of the technology or the capability, although clearly important, cannot by itself answer these questions. And, as shown, the divergent strategic objectives we subscribe to are often interwoven into our assessment of the technology.

So how should someone approach the hypersonic missile debate? Before adjudicating among conflicting technological assessments—deciding whether hypersonic missiles are undefendable, or easier to defend, untraceable or easier to track, extremely precise or widely imprecise—they may want to begin with considering the U.S. relationship with Russia and China. How much of our military focus should be on Russia and China? How much of our focus should be on a major conflict with Russia and China? What should be our military aims for such a conflict? What are the parameters, if any, for how we should prepare? From there, we can consider the technology with clearer eyes, untangling the technological from the strategic.

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[21] Dean Wilkening, "Conventional Prompt Strike in 2030 and Beyond," chapter in *Fit for Purpose: U.S. Strategic Posture for 2030 and Beyond*, edited by Brad Roberts, pages 55-65 (Center for Global Security Research, Lawrence Livermore National Laboratory, October 2020). https://cgsr.llnl.gov/content/assets/docs/The-US-Strategic-Posture-in-2030-and-Beyond.pdf.

[22] Tom Bussing, "Winning the hypersonics race is a national imperative." *Defense News*, January 10, 2020. https://www.defensenews.com/opinion/commentary/2020/01/10/winning-the-hypersonic-race-is-a-national-imperative/

[23] Interview with Matthew Kroenig, 2019.

[24] Steve Simon, "Hypersonic Missiles Are a Game-Changer." *The New York Times,* January 2, 2020. https://www.nytimes.com/2020/01/02/opinion/hypersonic-missiles.html.

[25] Dean Wilkening, "Hypersonic Weapons and Strategic Stability." The International Institute for Strategic Studies, September 2019. https://www.iiss.org/publications/survival/2019/survival-global-politics-and-strategy-octobernovember-2019/615-10-wilkening.

[26] Interview with Matthew Kroenig, 2019.

[27] Tirpak, 2018.

[28] Deptula, 2018.

[29] Interview with Mark Schneider, 2019.

[30] In an interview in 2019, Mark Schneider said: "Russia knows our missile defenses are not a threat to their existing strategic systems. They want these systems because they want the edge in a conflict."

[31] For example, Alan Cummings writes about Russian and Chinese reactions to U.S. nuclear-armed hypersonic weapons: "Washington should want Moscow and Beijing to react with some apprehension. Their reaction would acknowledge Washington's signal of commitment to deterring their revisionist ambitions and defending U.S. allies." For more information, see "High Speed, Low-Yield: A U.S. Dual-Use Hypersonic Weapon," *War on the Rocks,* September 17, 2020. https://warontherocks.com/2020/09/high-speed-low-yield-a-u-s-dual-use-hypersonic-weapon/.

[32] Alan Cummings, "High Speed, Low-Yield: A U.S. Dual-Use Hypersonic Weapon." *War on the Rocks,* September 17, 2020. https://warontherocks.com/2020/09/high-speed-low-yield-a-u-s-dual-use-hypersonic-weapon/.

[33] Interview with Matthew Kroenig, 2019.

[34] Some analysts have questioned the durability of the nuclear stalemate, the state of affairs in which countries are confident that their adversaries would not be able to undermine their nuclear deterrent capability. For example, see *The Myth of the Nuclear Revolution* by Kier A. Lieber and Daryl G. Press, Cornell Press: 2020.

[35] As another example, see "Stalking the Secure Second Strike: Intelligence, Counterforce, and Nuclear Strategy" by Austin Long and Brendan Rittenhouse Green, *The Journal Strategic Studies,* Vol. 38, Nos. 1-2, 38-73, 2015.

[36] Interview with Rebeccah Heinrichs, 2020.

[37] For example, Tom Karako of the Center for Strategic & International Studies has said: "It's where they travel and how they travel" that makes it difficult to stop them, adding: "…you don't know … [if the missiles are] coming from this direction or from that direction. And so your defense problem is more complicated." For more information, see "Clock Ticking for U.S. Military to Defend Against Hypersonics" by Jon Harper, *National Defense Magazine*, August 3, 2018. https://www.nationaldefensemagazine.org/articles/2018/8/3/clock-ticking-for-us-military-to-defend-against-hypersonics

[38] Capitol Hill briefing: "Understanding Russia and China's Newest Threat: Hypersonic Weapons and Implications for U.S. Security." American Foreign Policy Council, March 29, 2019. https://www.afpc.org/news/events/afpc-capitol-hill-briefing-understanding-russia-and-chinas-newest-threat-hypersonic-weapons-and-implications-for-u.s.-security

[39] Ibid.

[40] Interview with Patty Jane Geller, 2020.

[41] See for example, Peter Garretson, "U.S. needs a space sensor layer to protect against hypersonic missiles." Washington Times, June 22, 2020. https://www.washingtontimes.com/news/2020/jun/22/us-needs-a-space-sensor-layer-to-protect-against-h/

[42] See also Douglas M. Fraser, Frank Gorenc and John S. Shapland, "Hypersonic Defense Requires Getting Space Sensor System Right." RealClearDefense, May 13, 2020. https://www.realcleardefense.com/articles/2020/05/13/hypersonic_defense_requires_getting_space_sensor_system_right.html

[43] See also Loren Thompson, "To Defeat Hypersonic Weapons Pentagon Aims to Build Space Sensor Layer." Forbes, February 4, 2020. https://www.forbes.com/sites/lorenthompson/2020/02/04/space-sensor-layer-is-the-pentagons-next-tech-mega-project/#515b35f2719d

[44] For example, in an interview in 2019, Peter Huessy of the Air Force Association said: "I don't particularly like this idea of mutual vulnerability. It basically means you trust the bad guys won't call your bluff and if they do, you are willing to risk Armageddon. That's why missile defense becomes an enormously valuable tool. Don't believe me? Ask Israel! To deal with Putin's escalate to win you absolutely need credible missile defenses."

[45] Interview with Rebeccah Heinrichs, 2020.

[46] Interview with Peter Huessy, 2019.

[47] For example, in an interview in 2019, Peter Huessy said: "You need to be able to blunt the first strike of hypersonics—whether that means you need to shoot down 10, 15, 20, 25, 50 of these things—I am not sure. If you have too few, you let the adversary use the weapon as if it is hegemonic tool to coerce you into not fighting."

[48] In an article entitled "Left of Launch," Riki Ellison of the Missile Defense Advocacy Association, writes: "Bringing together offensive and defensive systems and structures to be fully integrated is the most effective and efficient means in defeating and deterring a threat both tactically and strategically." For more information, see "Left of Launch," Missile Defense Advocacy Alliance, March 16, 2015. https://missiledefenseadvocacy.org/alert/3132/

[49] See also, Brian R. Green, "Offense-Defense Integration for Missile Defeat." Center for Strategic & International Studies Missile Defense Project, July 2020. https://csis-website-prod.s3.amazonaws.com/s3fs-public/publication/200706_Green_MissileDefense_FINAL.pdf

[50] As another example, see Herbert C. Kemp, "Left of Launch: Countering the Ballistic Missile Threat." Atlantic Council, July 2017. https://www.atlanticcouncil.org/wp-content/uploads/2017/07/Left_of_Launch_web_0731.pdf

[51] Interview with DOD official, 2019.

[52] As another example of this idea, in an interview in 2019, James N. Miller, formerly the Under Secretary of Defense for Policy, said: "At the strategic level, the biggest concern is the potential for unwarned attack with hypersonic missiles on command and control." Based in part on this concern, Miller said he supports a space-based sensor layer and with resilient 24x7 coverage of key U.S. strategic locations.

[53] Acton, 2019 (*The Washington Post*).

[54] In an interview in 2019, James Acton said: "The area where hypersonics makes the biggest difference is conventional threats to the homeland. If you think about how much critical military infrastructure we have that we have not bothered to harden, including NC3 systems, satellite-uplinks and down-links, a credible conventional threat is pretty worrying…For nuclear-delivery systems, I don't see hypersonic missiles changing the threat. We are already vulnerable to Russian and Chinese short-range and long-range nuclear-armed systems."

[55] In an interview in 2020, Kingston Reif of the Arms Control Association said in reference to intercontinental hypersonic glide vehicles: "If the hypersonic missile is conventionally armed, then it would be a new threat. To the extent that it could hold critical military infrastructure or U.S. nuclear forces at risk, that would be a serious non-nuclear threat to the United States."

[56] At a conference hosted by the Center for Strategic & International Studies in October 2020, Ankit Panda of the Carnegie Endowment for International Peace said: "[Hypersonic glide vehicles] do not keep me up at night right now. What would make [hypersonic glide vehicles] keep me up at night is a direct threat to the homeland from a non-nuclear [hypersonic glide vehicle]." He noted that such capabilities would present a concern to "U.S. nuclear command and control" and potentially for an "American second-strike capability." For more information, see Center for Strategic and International Studies, Project on Nuclear Issues, "Virtual Conference: International Security at the Nuclear Nexus," October 21-22, 2020, Day 2, https://www.csis.org/events/online-event-international-security-nuclear-nexus-day-2.

[57] Acton, 2019 (*The Washington Post*).

[58] In an interview in 2019, Jon Wolfsthal said: "In response [to Russian and Chinese hypersonic missile developments], I would diversify and harden. I would think much more aggressively about redundancies and hardening so we have a functioning command and control system and not be vulnerable to the weak node threat. In the same vein, I would also take steps

to preserve continuity of operations of national command authority, not having to use or lose our systems."

[59] Interview with James Acton, 2019.

[60] As an example, Ivan Oelrich of the Council on Strategic Risks writes: "Many descriptions of hypersonic weapons note that they will be difficult to impossible to defend against. But this situation is nothing new: None of the big military powers, much less North Korea and Iran, can now defend effectively against long-range ballistic missiles." For more information, see "Cool your jets: Some perspective on the hyping of hypersonic weapons," Bulletin of the Atomic Scientists, Vol. 76, 2020. https://www.tandfonline.com/doi/abs/10.1080/00963402.2019.1701283

[61] As another example, Ivan Oelrich also writes skeptically of hypersonic missiles in a separate piece: "The next question should be 'So what?' Almost every article mentions that hypersonic gliders are maneuverable, so their target points cannot be predicted. Well, the target point of a ballistic missile also can't be predicted before it is launched 15 to 40 minutes before impact. So what? If the United States could predict where these weapons were headed—say, through the services of a psychic—what would it do with that information? In most cases, there is little it can do, whether the attack is from hypersonic gliders or ballistic missiles." For more information, see "Hypersonic missile questions everyone should ask?" Bulletin of the Atomic Scientists, December 16, 2019. https://thebulletin.org/2019/12/hypersonic-missiles-three-questions-every-reader-should-ask/

[62] Interview with Jeffrey Lewis, 2019.

[63] Cameron Tracy, "Setting the Record Straight on Hypersonic Weapons." Union of Concerned Scientists, February 3, 2020. https://allthingsnuclear.org/ctracy/setting-the-record-straight-on-hypersonic-weapons.

[64] For example, see Cameron Tracy, "The Accuracy of Hypersonic Weapons: Media Claims Miss the Mark." Union of Concerned Scientists, March 9, 2020. https://allthingsnuclear.org/ctracy/the-accuracy-of-hypersonic-weapons-media-claims-miss-the-mark.

[65] As another example specific to Avangard, see Jeffrey Lewis, Aaron Stein, and James Acton, "Avangard: A Boost-Guide Primer." Arms Control Wonk Podcast, January 23, 2019. https://poddtoppen.se/podcast/872594726/arms-control-wonk/avangard-a-boost-guide-primer.

[66] Ivan Oelrich, "Cool your jets: Some perspective on the hyping of hypersonic weapons." Bulletin of the Atomic Scientists, Vol. 76, 2020. https://www.tandfonline.com/doi/abs/10.1080/00963402.2019.1701283

[67] Tracy, February 2020.

[68] Interview with Jeffrey Lewis, 2019.

[69] In an interview in 2020, Cameron Tracy said: "We should avoid arms races. They are dangerous. Empirically, arms races increase the likelihood of conflict."

[70] As another example, Jeffrey Lewis said in an interview in 2019: "I believe deterrence will only really hold as long as there are secure retaliatory capabilities, so I am not particularly interested in arms racing Russians and Chinese to try to deny them these capabilities. I think we should be happy with the balance of deterrence."

[71] Interview with Cameron Tracy, 2020.

[72] Eric Gomez, "It Can Get You Into Trouble, But It Can't Get You Out: Missile Defense and the Future of Nuclear Stability," chapter in *America's Nuclear Crossroads: A Forward-Looking Anthology*, edited by Caroline Dorminey and Eric Gomez, pages 17-29 (Washington: Cato Institute, 2019). https://research.cato.org/americas-nuclear-crossroads

[73] Interview with Jill Hruby, 2020.

[74] Interview with Tim Morrison, 2020.

[75] There is a robust debate over whether to develop new missiles to target Russia and China's mainland. As an example, see Mike Griffin, Bryan Clark, and Michael O'Hanlon's comments in "Will ground-based hypersonic missiles replace the aircraft carrier in the defense budget?" by David Larter, *Defense News,* October 13, 2019. https://www.defensenews.com/naval/2019/10/14/will-ground-based-hypersonic-missiles-replace-aircraft-carriers-in-the-defense-budget/.

[76] As another example, Michael O'Hanlon of Brookings Institution has advocated for indirect measures, such as sanctions against Russia and China, and has warned about the escalatory effect of missile strikes: "To win, we might wind up feeling the need to attack Chinese submarines in port, missile launchers on mainland soil, and Chinese command and control networks that are also used for China's nuclear arsenal. Escalation could certainly ensue; China could easily respond with attacks against U.S. bases in Japan or beyond. Any such scenario would be highly fraught and not easily or confidently won." For more information, see "What the Pentagon's new report on China means for US strategy — including on Taiwan," Brookings Institution, September 4, 2020. https://www.brookings.edu/blog/order-from-

chaos/2020/09/04/what-the-pentagons-new-report-on-china-means-for-u-s-strategy-including-on-taiwan/.

[77] Wilkening, 2020.

[78] As another example, at a panel in 2019, Dean Wilkening said that the two strategic reasons why the United States should pursue hypersonic weapons are to (1) defeat Russian and Chinese integrated air defense systems and to (2) target Chinese mobile missiles. For more information, see Carnegie Endowment for International Peace, "Hypersonic Missiles: Assessing the Benefits and Risks," July 19, 2019. https://carnegieendowment.org/2019/07/09/hypersonic-missiles-assessing-benefits-and-risks-event-7151

[79] This view relates to *Enable Global Missile War,* one of the schools of thought described by Russell Rumbaugh in his paper on competing visions of the role of space in future war. For more information, see *What Place for Space: Competing Schools of Operational Thought in Space,* The Aerospace Corporation, June 2019. https://aerospace.org/sites/default/files/2019-07/Rumbaugh_PlaceForSpace_07172019.pdf.

[80] In an interview in 2020, Cameron Tracy said: "Hypersonic missiles are often slower than ballistic missiles and produce a lot of heat, which makes them easy to detect. In some respects, they may be harder to defend against than ballistic missiles, but in other ways they may be easier to defend against…I don't think we should be focusing on capabilities to target Russian and Chinese strategic sites."

[81] Interview with Melissa Hanham, 2020.

[82] As an example, in an interview in 2020, Jill Hruby said: "I think that the original intent of targeting a terrorist cell with a quick strike is still attractive."

[83] Other experts pointed to Chinese maritime assets as attractive targets for hypersonic missiles. Said one former defense official: "I would focus on counter maritime. Given the concentration in value in surface ships, they are just exceptional targets. Hypersonics are expensive but the idea of a hypersonic salvo attack against a ship looks pretty compelling and the cost-ratio looks pretty good. And for a maritime power, to retard an up-and-coming maritime power, that looks pretty attractive." When asked about the use of hypersonic weapons against mainland China, the former official said, "It is tricky to think about targets from a conventional strike on another nuclear power that may not lead to World War III. Theoretically, it could be a great counter command and control weapon but how escalatory would that be? And I still believe in old-fashioned assured second-strike capabilities of the big nuclear powers. Counter-maritime, surface fleets of the great powers, seem less escalatory and look like great target sets." The former official recommended a "a niche capability."

[84] For example, the authors of an August 2020 primer on hypersonic weapons in the Indo-Pacific region devote a section to the debate over hypersonics, which they center on technological discussions. "Many analysts argue that the combined speed and maneuverability of these weapons compress decision-making processes and vastly increase survivability over modern air and missile defense systems, thereby embodying a 'game changer.' Others are skeptical and argue that hypersonic weapons merely produce the same military effects achieved by existing capabilities, including ballistic and cruise missiles." For more information, see "Primer on hypersonic weapons in the Indo-Pacific region" by John T. Watts, Christian Trotti, and Mark J. Massa, The Atlantic Council, August 2020. https://www.atlanticcouncil.org/in-depth-research-reports/report/primer-on-hypersonic-weapons-in-the-indo-pacific-region/

[85] As an example, Rebeccah Heinrichs writes: "the United States must reject the notion that strategic stability is achieved by remaining vulnerable to Russian and Chinese nuclear weapons," adding that we are not "obligated as a matter of stability or moral responsibility to expose our allies or American citizens to nuclear attack." For more information, see "Bolster American missile defense until Russia provides itself in treaty," The Hill, August 18, 2018. https://thehill.com/opinion/national-security/402485-bolster-american-missile-defense-until-russia-proves-itself-in

[86] As another example of this sentiment, Henry Obering III and Rebeccah L. Heinrichs write, "Building up and configuring the US homeland missile defense architecture such that China would not be sure it could successfully land a few [intercontinental ballistic missiles] on U.S. soil only decreases the likelihood that China would attempt it." For more information, see "Missile Defense for Great Power Conflict: Outmaneuvering the China Threat," Strategic Studies Quarterly, Winter 2019. https://www.airuniversity.af.edu/Portals/10/SSQ/documents/Volume-13_Issue-4/Heinrichs.pdf

[87] As an example, see "To Deter War with China, Defend Guam" by Rebeccah L. Heinrichs, The Hudson Institute, July 11, 2020. https://www.hudson.org/research/16217-to-deter-war-with-china-defend-guam

[88] Richard H. Speier, George Nacouzi, Carrie Lee, Richard M. Moore, "Hypersonic Missile Nonproliferation: Hindering the Spread of a New Class of Weapons." RAND Corporation, 2017. https://www.rand.org/pubs/research_reports/RR2137.html

[89] In 2018, Lieutenant General Samuel Greaves, the Director of the Missile Defense Agency, suggested North Korea and Iran could eventually obtain hypersonic missiles. When asked about the risk that China and Russia's hypersonic missile technology will be proliferated to countries like North Korea and Iran, Greaves responded: "I assess that risk as extremely high…I don't see what will prevent it from happening." He added that this is the reason why "the hypersonic threat is something that we need to address expediently." For more information, see "Iran and North Korea: Soon to Build Hypersonic Missiles?" by Zachary Keck, *The National Interest,* September 15, 2019. https://nationalinterest.org/blog/buzz/iran-and-north-korea-soon-build-hypersonic-missiles-80836

[90] In an interview in 2019, James Acton said: "I think there's an important distinction between theater and homeland defense. Given unsettled sovereignty issues, I think we are going to be locked in a theater competition with Russia and China for the foreseeable future. Therefore, I think defenses against Russian and Chinese hypersonics in a theater sense are appropriate. Alternatively, I believe homeland defenses against Russian and Chinese nuclear hypersonic systems are a bad investment. Russia and China will do whatever is required to ensure their nuclear weapons are penetrating whatever defenses we put up."

[91] In an interview in 2019, Frank Rose of the Brookings Institution said: "It will be very difficult (and expensive) to develop an effective defense against Russia and Chinese hypersonic threats to the U.S. homeland. I think we should rely on nuclear deterrence to deter that threat. On the other hand, I'm in favor of exploring options for defending against theater-level hypersonic threats, though developing an effective theater defense capability will likely be challenging as well."

[92] Interview with Laura Grego, 2020.

[93] For example, Samran Ali discusses new intercept systems, space-based intercepts, and boost-phase missile defense, among other potential solutions to hypersonic missiles. For more information, see "All the Secret (Or Not) Ways to Kill a Hypersonic Missile," *The National Interest,* June 24, 2019. https://nationalinterest.org/blog/buzz/all-secret-or-not-ways-kill-hypersonic-missile-64031.

[94] Laura Grego said in an interview in 2020 that "you might be able to use point-defenses like [Terminal High Altitude Area Defense] against hypersonic missiles in theater."