



JAMES M. ACTON

**IS
IT A
NUKE?**

**Pre-Launch
Ambiguity
and Inadvertent
Escalation**



CARNEGIE
ENDOWMENT FOR
INTERNATIONAL PEACE

JAMES M. ACTON

IS

IT A

**Pre-Launch
Ambiguity
and Inadvertent
Escalation**

NUKE?

© 2020 Carnegie Endowment for International Peace. All rights reserved.

Carnegie does not take institutional positions on public policy issues; the views represented herein are the author's own and do not necessarily reflect the views of Carnegie, its staff, or its trustees.

No part of this publication may be reproduced or transmitted in any form or by any means without permission in writing from the Carnegie Endowment for International Peace.

Please direct inquiries to:

Carnegie Endowment for International Peace

Publications Department

1779 Massachusetts Avenue NW

Washington, DC 20036

P: +1 202 483 7600

F: +1 202 483 1840

CarnegieEndowment.org

This publication can be downloaded at no cost at CarnegieEndowment.org.

CONTENTS

About the Author	v
Acknowledgments	vii
Abbreviations	ix
Summary	1
CHAPTER 1	
Introduction	7
CHAPTER 2	
Why Worry About Pre-Launch Warhead Ambiguity?	13
CHAPTER 3	
The Evolution of Ambiguous Weapons	17

CHAPTER 4

Why Warhead Ambiguity Can Cause Mischaracterization Pre-Launch	25
---	-----------

CHAPTER 5

Why Warhead Ambiguity Could Lead to Escalation	37
---	-----------

CHAPTER 6

Conclusions and Recommendations	47
--	-----------

Appendix: France, India, Pakistan, and North Korea	55
---	-----------

Notes	59
--------------	-----------

Carnegie Endowment for International Peace	75
---	-----------

ABOUT THE AUTHOR

JAMES M. ACTON holds the Jessica T. Mathews Chair and is co-director of the Nuclear Policy Program at the Carnegie Endowment for International Peace. A physicist by training, Acton's current research focuses on the escalation risks of advanced conventional weapons and the future of arms control. His work on escalation includes the Carnegie edited volume, *Entanglement: Chinese and Russian Perspectives on Non-nuclear Weapons and Nuclear Risks*, and the *International Security* article "Escalation through Entanglement."

Acton's publications span the field of nuclear policy. They include the Carnegie report, *Wagging the Plutonium Dog*, and two Adelphi books, *Deterrence During Disarmament* and *Abolishing Nuclear Weapons* (with George Perkovich). He co-wrote *Why Fukushima Was Preventable*, a groundbreaking study into the root causes of the accident.

An expert on hypersonic conventional weapons and the author of the Carnegie report, *Silver Bullet? Asking the Right Questions About Conventional Prompt Global Strike*, Acton has testified on this subject to the U.S. House of Representatives Armed Services Committee and the congressionally chartered U.S.-China Economic and Security Review Commission.

Acton is a member of the Nuclear Security Working Group and the International Advisory Council for the Luxembourg Forum on Preventing Nuclear Catastrophe. He has published in the *New York Times*, the *Wall Street Journal*, the *Washington Post*, *Dædalus*, *Foreign Affairs*, *Foreign Policy*, *Science & Global Security*, and *Survival*. He has appeared on CNN's *State of the Union*, NBC *Nightly News*, CBS *Evening News*, and PBS *NewsHour*.

ACKNOWLEDGMENTS

This work was made possible by a generous grant from the John D. and Catherine T. MacArthur Foundation. It benefited enormously from the extraordinary research skills of Nicholas Blanchette, Gaurav Kalwani, Valeriia Lozova, Kayla Matteucci, and Thu-An Pham. I am also indebted to Carnegie’s outstanding communications department—in particular, Lori Merritt and Jocelyn Soly—for their excellent work in editing, design, and production. Finally, for their insightful conversations and/or trenchant critiques of earlier drafts, I would like to thank William J. Burns, Thomas Carothers, Toby Dalton, Scott LaFoy, George Perkovich, Pavel Podvig, Joshua H. Pollack, Jen Psaki, Vince Manzo, Vipin Narang, Nicholas Wright, and members of Carnegie’s Nuclear Policy Program. However, I am solely responsible for this report’s contents.

ABBREVIATIONS

CIA	Central Intelligence Agency
ICBM	Intercontinental ballistic missile
INF TREATY	Intermediate-Range Nuclear Forces Treaty
IRBM	Intermediate-range ballistic missile
ISR	Intelligence, surveillance, and reconnaissance
KPA	Korean People's Army
NATO	North Atlantic Treaty Organization
PLA	People's Liberation Army
SLBM	Sea-launched ballistic missile
SSBN	Ballistic missile submarine

SUMMARY

Ambiguity about whether a weapon is nuclear-armed prior to its launch is an underappreciated, serious, and growing danger. Rising geopolitical tensions and the decay of arms control are exacerbating the risk that such pre-launch warhead ambiguity could lead to nuclear use in a crisis or conflict. Recent developments in technology—as well as potential future advances, such as the development of ambiguous intercontinental missiles—further add to the danger.

A first step toward reducing these risks is to enhance awareness among decisionmakers of the causes and potential consequences of ambiguity. Unilateral and cooperative risk-mitigation measures could further reduce the danger of escalation, including in conflicts between the United States and Russia or the United States and China.

Basic concepts. As a result of warhead ambiguity, one state may mischaracterize an adversary's weapons—that is, wrongly assess how they are armed—or be unable to characterize them. Mischaracterization can lead to a false positive (misidentifying a nonnuclear weapon as a nuclear one) or a false negative (misidentifying a nuclear weapon as a nonnuclear one). If mischaracterization or uncertain characterization is unintended, then any resulting escalation can be classified as inadvertent.

An overlooked danger. To date, the debate about warhead ambiguity has mostly focused on the risk of a nonnuclear weapon being mistaken for a nuclear weapon after launch. Pre-launch dangers, especially those arising from false positives, have attracted much less attention. Mischaracterization and uncertainty prior to launch, however, have occurred frequently throughout the nuclear age. Moreover, the escalation risks associated with pre-launch ambiguity could be more serious than the post-launch risks for three reasons. First, pre-launch ambiguity could persist over a much longer time window, thus allowing states to exercise options that they would not have time to implement between the launch of an adversary's weapons and their detonation. Second, false negatives could not increase escalation risks after launch, but they could do so beforehand. Third, post-launch ambiguity could only spark escalation in a conflict involving the United States or Russia because they are the only states capable of initiating a nuclear response prior to the detonation of incoming weapons. By contrast, pre-launch ambiguity could lead to escalation in crises and conflicts involving other states.

Technology and ambiguity. The likelihood of mischaracterization or uncertainty about how a weapon is armed is greatest for ambiguous delivery systems—that is, superficially similar nuclear and nonnuclear delivery systems and dual-use delivery systems (for which both nuclear and conventional warheads are available and which can carry either). Ambiguous aircraft and ground-launched cruise and ballistic missiles are most salient to an analysis of the risks of pre-launch ambiguity.

China, Russia, and the United States, which are the focus of this report, all deploy ambiguous delivery systems; and all Chinese, Russian, and U.S. aircraft with a nuclear mission are dual-use. China and Russia deploy ambiguous ground-launched ballistic missiles, while Russia also fields dual-use ground-launched cruise missiles. The United States, meanwhile, is seeking to reacquire a nuclear-armed sea-launched cruise missile, which, even if it is not dual-use, will likely reintroduce ambiguity to U.S. naval forces by being deployed on a platform that does not currently carry nuclear weapons.

The significance of ambiguous delivery systems is set to increase even further. Technological developments could permit China and Russia, in particular, to deploy more accurate ambiguous ground-launched missiles of progressively longer ranges—especially in Russia's case, now that the 1987 Intermediate-Range Nuclear Forces Treaty has collapsed.

Causes of mischaracterization or uncertainty. Incorrect or uncertain conclusions about how an ambiguous delivery system is armed can result from intelligence analysts' misinterpretation of the imperfect information available to them. Equally likely to generate false positives or false negatives, this misinterpretation can have various causes:

- Assessments about whether a delivery system has a nuclear role, a conventional role, or both may be incorrect or uncertain. Recent public U.S. assessments, for example, indicate uncertainty about whether nuclear warheads are available for certain foreign delivery systems that clearly have a nonnuclear role.
- Distinguishing between superficially similar nuclear and nonnuclear weapons can be difficult. The United States, for instance, faced this challenge when the Soviet Union sold ambiguous MiG-23 aircraft to Cuba in the late 1970s.
- Analysts may misjudge, or have insufficient information to judge, what types of warheads are loaded onto or available for dual-use systems—a challenge that currently faces the North Atlantic Treaty Organization in characterizing Russian forces deployed in Kaliningrad.

Deployment patterns and practices can make it even more difficult to characterize ambiguous delivery systems, particularly when both nuclear and nonnuclear versions of the same system are deployed simultaneously. For example, in the run-up to the Cuban Missile Crisis, the Soviet Union shipped nuclear and conventional cruise missiles to Cuba, but the U.S. Central Intelligence Agency failed to identify the difference and assessed them all to be conventionally armed.

All dual-use U.S. aircraft are available for both nuclear and nonnuclear operations; they are not grouped, geographically or organizationally, according to function. Likewise, Russia appears to group few, if any, of its ambiguous aircraft and ground-launched missiles functionally. In the fog of a crisis or conflict, the entanglement of nuclear and nonnuclear delivery systems being operated side by side could pose a further challenge to characterization.

China, by contrast, appears to operate geographically and organizationally distinct launch brigades for nuclear and conventional missiles (although internal pressures to end this practice may be growing). However, the deployment areas for nuclear and nonnuclear variants of the same missile may overlap, potentially leading to intermingling and hence greater characterization challenges in a crisis or conflict. Moreover, in a crisis or conflict, China's efforts to obscure its missile operations might add to the difficulty by hampering the United States' ability to track Chinese missiles after leaving their garrisons.

If intelligence analysts cannot draw firm conclusions about how ambiguous delivery systems are armed, national and military leaders may assume, for both military and psychological reasons, that those weapons are loaded with nuclear warheads—potentially yielding false positives. For example, during the Cuban Missile Crisis, when confronted with multiple deployments of ambiguous Soviet systems, U.S. decisionmakers assumed that two types of aircraft were nuclear-armed, even though there was little direct evidence to support their conclusion.

Escalation risks. Mischaracterization, unlike uncertainty, could increase the risks of inadvertent escalation for two reasons. First, warhead ambiguity could obfuscate signaling operations and increase the already significant challenges of communicating and assessing intent.

- False negatives could lead to an intended nuclear signal being missed, potentially prompting the signaler to further escalate the crisis or conflict because it concluded its message had been ignored. Historically, nuclear signals have been missed even without the complications introduced by warhead ambiguity. In theory, states could clarify the meaning of signaling operations involving ambiguous delivery systems by, for instance, issuing public or private statements or threats. In reality, however, such measures would come with downsides and might not be implemented fully or even at all.
- False positives, meanwhile, could lead a state to conclude incorrectly that its adversary was issuing a nuclear signal or undertaking clandestine preparations for nuclear use. While such a misinterpretation could unintentionally lead to deescalation, it would more likely catalyze an escalation spiral. Historically, nuclear operations and threats have led to reciprocal escalation, even if the resulting spirals ended short of nuclear use. For example, during the 1973 Yom Kippur War, the United States' incorrect belief that Soviet nuclear warheads were being transported to Egypt helped spark a U.S. nuclear alert, which may, in turn, have prompted the start of a Soviet alert.

Second, in any crisis or conflict, each adversary would devote significant resources to collecting intelligence about the other's military capabilities. However, by degrading the quality of intelligence information, warhead ambiguity—especially if it resulted in false negatives—could increase the likelihood of a state's initiating a potentially escalatory military operation because it had underestimated the dangers of doing so.

Recommendations. However desirable it might be for nuclear-armed states to reassess their reliance on ambiguous delivery systems, they are highly unlikely to do so for strategic, financial, psychological, and organizational reasons. Less ambitious unilateral and cooperative risk-reduction measures may be more feasible. The following proposals are framed as actions for the United States to consider and adopt. But risk mitigation should be a shared responsibility, and Beijing and Moscow have an obligation to engage constructively with any good-faith proposals Washington offers and, in parallel, develop their own unilateral risk-reduction measures. The United States, meanwhile, has an obligation to seriously consider how it could address Chinese and Russian concerns about the survivability of their nuclear forces, which should help increase Moscow's and Beijing's interest in cooperative risk reduction.

Exercise Restraint in Acquisitions. The U.S. secretary of defense should require relevant Department of Defense decisionmakers to consider any potential escalation risks resulting from warhead ambiguity when deciding whether to acquire new categories of ambiguous weapons. To this end, those decisionmakers should be presented with a formal assessment of such risks.

The United States should propose to China and Russia that they jointly agree not to acquire ambiguous intercontinental ballistic, cruise, or hypersonic boost-glide missiles.

Be Transparent About Capabilities. The United States should propose to China and Russia that they declare, publicly or privately, each type of missile and aircraft that they deploy as nuclear-armed, conventionally armed, or dual-use.

The United States should propose to China and Russia that they privately discuss any observable differences in design or deployment patterns between their nuclear- and conventionally armed ambiguous weapons.

Improve Operational Planning. The U.S. Department of Defense and relevant combatant commands should plan for crises and conflicts on the assumption that each participant might mischaracterize or be unable to characterize the other's ambiguous weapons.

The U.S. secretary of defense should require relevant decisionmakers to consider any potential escalation risks resulting from warhead ambiguity when deciding whether to authorize strikes with or against ambiguous delivery systems. To this end, those decisionmakers should be presented with a formal assessment of such risks.

U.S. military planners and decisionmakers should be aware of the trade-offs associated with using ambiguous delivery systems for signaling operations.

If the United States uses ambiguous delivery systems for nuclear signaling, it should take steps to mitigate the risks associated with warhead ambiguity by, for example, clarifying the meaning of the signal in an accompanying statement.

The United States should offer verbal assurances to reduce the likelihood of false positives resulting from operations involving conventionally armed ambiguous weapons.

CHAPTER 1

INTRODUCTION

On July 15, 1948, three weeks after the Soviet Union had begun its blockade of Berlin, the United States announced the dispatch of B-29 bombers to Great Britain and Germany on what was officially described as a training exercise but was actually a message to Moscow. Although the intended meaning—that the United States was prepared to use nuclear weapons to defend Europe—would likely have been obvious to the Soviet leadership, the administration of U.S. president Harry Truman took pains to drive its point home. Official press releases described the aircraft as “atomic-capable.”¹ At the same time, a *New York Times* article based on “authoritative sources” reminded readers that it was B-29 bombers that had dropped nuclear weapons on Hiroshima and Nagasaki.² While U.S. officials did not lie, the overall impression they created was misleading. Although all B-29s were theoretically capable of carrying an atomic bomb, the specific aircraft sent to Europe had not been modified to do so. In other words, the United States conveyed its first nuclear threat with weapons that were incapable of enacting it and, in so doing, created a risk that Moscow could have interpreted this threat as a bluff.

Fourteen years later, in the summer of 1962, in the run-up to what would turn out to be the Cold War’s most dangerous moment, the Soviet Union shipped about eighty coastal defense cruise missiles and their nuclear warheads to Cuba, along with the medium- and intermediate-range ballistic missiles (IRBMs) that sparked the Cuban Missile Crisis. U.S. intelligence spotted the cruise missiles but incorrectly assessed them to be conventionally armed.³ As a result, plans for the invasion of Cuba, which the U.S. military drew up during the crisis, were based on intelligence that seriously underestimated Soviet capabilities to defend the island.

In 2017, as U.S.–North Korean tensions spiraled more than twenty-five years after the Cold War’s conclusion, the United States conducted a series of exercises around the Korean Peninsula involving B1-B bombers. These operations were explicitly intended to be a “demonstration of U.S. resolve,” but the signal was meant to be a purely conventional one: B1-B bombers ceased to have a nuclear mission in 1994 and were subsequently modified so they could not carry nuclear weapons.⁴ Yet, if its statements can be believed, North Korea misinterpreted the signal. Pyongyang claimed that the B1-B was nuclear-capable (if not actually nuclear-armed at the time), describing one exercise as a “nuclear bomb dropping drill” and another as a “surprise nuclear strike drill,” while branding the U.S. military as “nuclear war maniacs.”⁵

In a crisis or conflict, pre-launch ambiguity could create serious risks of escalation by leading one state to misjudge its opponent’s willingness to use nuclear weapons or that opponent’s nuclear or nonnuclear capabilities.

In each of these three events, which span the nuclear age, ambiguity about whether delivery systems were nuclear-armed generated a significant risk of escalation prior to any use of those weapons. Indeed, that risk could recur in a future U.S.–North Korean crisis. Yet almost all of the academic and policy debates surrounding the consequences of such *warhead ambiguity* have focused on risks after an attack has

been initiated (but before the warhead has detonated)—that is, on *post-launch ambiguity*. Controversy has surrounded, for example, the United States’ program to build a new nuclear-armed cruise missile, the Long-Range Standoff weapon, because of fears that Russia might wrongly conclude that a conventional cruise missile fired in anger was nuclear-armed and quickly respond in kind.⁶ Fortunately, post-launch ambiguity has remained only a theoretical possibility (with the probable exception of the U.S. nuclear attack on Hiroshima in 1945 when a nuclear-armed aircraft was presumably misperceived as being nonnuclear).⁷ By contrast, *pre-launch ambiguity* has been relatively prevalent, and its associated risks therefore deserve systematic analysis.

In a crisis or conflict, pre-launch ambiguity could create serious risks of escalation by leading one state to misjudge its opponent’s willingness to use nuclear weapons or that opponent’s nuclear or nonnuclear capabilities. Nuclear use could be a direct result; or in less extreme circumstances, an escalating series of moves and countermoves—threats, signals, and conventional military operations—could plausibly result in nuclear use. While estimating the likelihood of such escalation is extremely difficult (if not impossible), the potential dangers are so extraordinary that the risks demand attention. After all, a conflict that turned nuclear could cause catastrophic societal destruction, including deaths numbering in the tens, or even hundreds, of millions.

For the sake of concreteness, it helps to analyze the dangers in the context of a crisis or conflict between the United States and China or the United States and Russia. The risks associated with pre-launch ambiguity in such a scenario are particularly significant and also intensifying for three reasons.

First, growing geopolitical tensions are raising the likelihood of the kinds of serious crises or conflicts in which pre-launch warhead ambiguity could contribute to rapid escalation. Reflecting these tensions, the U.S. Department of Defense has identified its “principal priorities” to be “long-term strategic competitions with China and Russia.”⁸ Beijing and Moscow, meanwhile, put the United States at the center of their own defense planning.

Second, improvements in technology are exacerbating the risks, including by enabling China and Russia to develop longer-range ballistic and hypersonic boost-glide missiles that can carry nuclear or nonnuclear warheads. The reach of these missiles exacerbates the potential threat they could pose to U.S. territory, forces, and assets. In a crisis or conflict, concerns that they might be used could increase pressure on Washington to act quickly by, for example, preemptively attacking missiles that it believed were conventionally armed. If, as a result of ambiguity, the United States’ actions were based on incorrect information, they could have unforeseen and dangerous consequences, such as the unintentional destruction of nuclear-armed missiles.

Third, particularly in the case of the United States and Russia, growing tensions are undermining cooperative measures that help to prevent crises and conflicts and mitigate the risk of escalation should a war occur. The United States and the Soviet Union, later Russia, led efforts to create the Euro-Atlantic security architecture, mostly in the years around the end of the Cold War. This system of agreements is now in a state of accelerating decay because of selective implementation, outright noncompliance, and abrogation. Agreements designed to make a war less likely by limiting military forces and enhancing transparency look ever more inadequate. The 1990 Conventional Forces in Europe Treaty is entirely defunct. The 1992 Open Skies Treaty and 2011 Vienna Document are less than completely functional. (Indeed, the United States has informed allies that it will withdraw from the Open Skies Treaty unless they find a way to assuage U.S. concerns about its effectiveness.)⁹ The demise of the 1987 Intermediate-Range Nuclear Forces (INF) Treaty, following Russian noncompliance and U.S. withdrawal, has a more direct effect on the problem at hand: The end of the prohibition against deploying ground-launched cruise and ballistic missiles with ranges between 500 and 5,500 kilometers (310 and 3,400 miles), irrespective of how they are armed, has removed a key legal barrier to the development—by Russia, in particular—of longer-range ambiguous missiles. Thus, the risks associated with pre-launch ambiguity have become even more acute.

KEY CONCEPTS

Before assessing the risks, it is useful to establish some basic concepts and definitions. Warhead ambiguity complicates the task of *characterizing* an adversary's weapons—that is, determining how they are armed. Of course, even when ambiguity arises, a state may characterize the weapons correctly. However, if the state does not, uncertainty or mischaracterization can lead to a *false positive* (misidentifying a nonnuclear weapon as nuclear) or a *false negative* (misidentifying a nuclear weapon as nonnuclear). For example, per the events described earlier, if Soviet leaders had concluded that the B-29 bombers deployed to Europe in 1948 were nuclear-armed, their belief would represent a false positive. Conversely, the United States' misperception that some Soviet cruise missiles deployed to Cuba during the 1962 crisis were conventional represents a false negative.

The case for worrying about pre-launch warhead ambiguity is presented in chapter 2. Launch is defined here as the moment, after an employment decision is made, when a delivery system is set in motion toward its target. Thus, in the case of a mobile missile, launch generally occurs when the missile separates from its launcher, not when the launcher is dispersed.¹⁰ For an aircraft, launch occurs at takeoff if the decision to attack a target has already been made, but it can also occur later if that is when an employment decision is made.

The likelihood of mischaracterization or uncertainty is greatest for *ambiguous delivery systems*, which are described in detail in chapter 3. Such delivery systems include dual-use weapons (for which both nuclear and conventional warheads are available and which can carry either) and superficially similar nuclear and nonnuclear weapons.¹¹ Both categories of weapons contribute to the growing entanglement of the nuclear and nonnuclear domains.¹² The risks of pre-launch ambiguity are greatest with ground-launched mobile missiles and aircraft because they can be visibly deployed for prolonged periods—hours, days, or, in the case of missiles, even weeks.

Ambiguity can induce uncertainty or mischaracterization at two separate bureaucratic levels, as discussed in chapter 4. Intelligence analysts may misinterpret—or be unable to conclusively interpret—the available information about how ambiguous delivery systems are armed. Especially in a crisis or conflict, such information could be limited in both quality and quantity. If analysts cannot reach a definitive conclusion, decisionmakers may feel that prudence requires them to assume that ambiguous weapons are nuclear-armed.

In turn, mischaracterization could spark escalation in two ways, as outlined in chapter 5. Most importantly, it could lead a state to underestimate or overestimate its opponent's willingness to use nuclear weapons, which could frustrate bargaining or lead to an overreaction. Alternatively, a state could develop an inaccurate picture of its adversary's nuclear or nonnuclear military capabilities and launch an operation whose dangers it had underestimated. Uncertainty, by contrast, would be less escalatory than mischaracterization because

it would not necessarily lead to misperception. But uncertainty is also less likely to occur than mischaracterization because decisionmakers tend to assume, without clear evidence to the contrary, that ambiguous weapons are nuclear-armed.

The focus here is on inadvertent escalation—that is, escalation resulting from unintended mischaracterization or uncertainty. Because Beijing, Moscow, and Washington command diverse and mature nuclear arsenals (even if Beijing’s nuclear force is small), they have little incentive to bluff, as the United States did in 1948.¹³ That said, as discussed briefly in chapter 5, China, in particular, may have a different reason to exploit warhead ambiguity: to enhance deterrence, it may be trying to increase the risk that strikes against its conventional forces would inadvertently destroy some of its nuclear weapons and spark escalation. (Outside of the U.S.-Russia-China triangle, intended ambiguity may be a more prominent feature of states’ strategies; Pakistan, for example, may seek to give the impression that at least one of its conventional missiles is dual-use.)¹⁴

Recognizing the escalation dangers created by pre-launch warhead ambiguity, China, Russia, and the United States ought to assess whether the benefits of ambiguous delivery systems outweigh the risks. However, as described in chapter 6, they are extremely unlikely to forsake such weapons, particularly for cost reasons. Realistically, though, states could assess the risks and develop practices to mitigate them, either unilaterally or, better still, cooperatively. For example, just as a state might accompany a nuclear signal with a warning designed to clarify its intent, it could issue reassurances about operations involving conventionally armed ambiguous weapon systems to reduce the likelihood that an adversary might mischaracterize the weapons as nuclear-armed.

Just as a state might accompany a nuclear signal with a warning designed to clarify its intent, it could issue reassurances about operations involving conventionally armed ambiguous weapon systems to reduce the likelihood that an adversary might mischaracterize the weapons as nuclear-armed.

Many of the issues discussed below raise questions of interpretation and perception. In assessing an adversary’s capabilities, how do intelligence analysts interpret ambiguous, incomplete information? If analysts cannot draw firm conclusions, how do decisionmakers deal with uncertainty in planning and conflict management? In peacetime, do decisionmakers regard escalation risks as sufficiently serious that they are motivated to put in place risk-reduction measures? To address such questions, this report draws on experimental psychology and, in particular, on a growing understanding of the ways in which biases and heuristics affect perception and decisionmaking under conditions of uncertainty.¹⁵ While the strength of such tendencies differ from person to person, this approach is nonetheless helpful in better understanding how typical analysts and decisionmakers might behave.

WHY WORRY ABOUT PRE-LAUNCH WARHEAD AMBIGUITY?

If warhead ambiguity leads to mischaracterization (as opposed to uncertainty), four different scenarios can arise, depending on when the mischaracterization occurs (pre- or post-launch) and whether it is a false positive or a false negative (see table 1).

So far, debates about the risks of ambiguous delivery systems have focused, almost exclusively, on just one scenario: a nonnuclear weapon's being mistaken for a nuclear weapon after it has been launched. This focus is not surprising, given concerns that the target state might launch an immediate nuclear counterstrike. Yet, while the consequences of post-launch warhead ambiguity could be extremely high, assessing the likelihood of this worst-case scenario has proved contentious, leading to a somewhat rancorous and ultimately static debate.¹⁶ Optimists argue that even if Russia, say, mischaracterized a small incoming conventional attack as nuclear, it would have no rational reason to launch an immediate response since its nuclear deterrent would not be in jeopardy. Pessimists argue that Russia might interpret a limited strike as the prelude to a large-scale attack and that even a small likelihood of escalation should be unacceptable because of the severity of the potential consequences.

In one way, pre-launch and post-launch ambiguity are closely connected: If a state mischaracterizes a weapon before launch, it will likely continue to do so afterward. Accordingly, understanding the likelihood of pre-launch ambiguity may help to shed light on the magnitude of the post-launch risks.

TABLE 1

Warhead Ambiguity and Misperceptions That Might Trigger Escalation

	False Positive	False Negative
Pre-launch	<ul style="list-style-type: none"> Overestimate the likelihood of nuclear use by the adversary. Underestimate the adversary's conventional capabilities. 	<ul style="list-style-type: none"> Underestimate the likelihood of nuclear use by the adversary. Underestimate the risks of conventional military action against the adversary.
Post-launch	<ul style="list-style-type: none"> Incorrectly conclude the adversary has launched a nuclear attack. 	<ul style="list-style-type: none"> Little additional escalation risk.^a

^a Escalation in this case would be likely, but this risk would stem from one state's launching a nuclear attack on a nuclear-armed adversary, not from that adversary's initial mischaracterization of the attack.

Yet, while the debate about post-launch ambiguity has been raging, potential causes, types, risks, and consequences of pre-launch ambiguity have been largely ignored. The only pre-launch scenario that has attracted significant attention is the risk of the United States' attacking ambiguous Chinese ballistic missiles that it believed were conventional but were actually nuclear-armed.¹⁷ In this case, China might conclude that its nuclear deterrent was under threat and therefore feel use-or-lose pressures that could precipitate escalation. This scenario, which involves a false negative, is indeed an important one, but concerns about the survivability of a nuclear arsenal are not the only potential cause of escalatory pressures. A state could also overestimate or underestimate its opponent's willingness to resort to nuclear use or misread that opponent's capabilities. False positives, as well as false negatives, could cause these kinds of misperceptions.

Moreover, pre-launch operations involving ambiguous dual-use aircraft, as well as ground-launched missiles, could spark escalation, which could feasibly occur in a U.S.-Russian or U.S.-Chinese contingency. In fact, the risks might be greater in a U.S.-Russian scenario given that Russia fields many more types of ambiguous delivery systems than either the United States or China.

Pre-launch ambiguity probably creates greater escalation risks than post-launch ambiguity for at least three reasons. First, pre-launch ambiguity could persist over a much longer time window. In a post-launch scenario, if a state were to misidentify one or more incoming nonnuclear weapons as nuclear, its leadership would face an essentially binary choice in the minutes before impact was expected: do nothing or launch a nuclear response.¹⁸ The likelihood of a nuclear response would probably be small, not least because of the technical dif-

difficulty of responding so quickly (though, as noted above, analysts disagree about precisely how small it would be and how small it should be for the risks of the incoming attack to be tolerable).

Yet, in a pre-launch scenario, the ambiguity could persist for much longer—weeks conceivably—and therefore allow the targeted state to consider a greater range of responses. Precisely because many of these options would be less extreme than nuclear use, the state would be more likely to take some kind of action.

Second, while false negatives could not increase escalation risks after a weapon's launch, they could do so beforehand. Before launch, false negatives could trigger escalation by, for example, frustrating attempts at nuclear signaling. After launch, a false negative could occur and further escalation would be likely.¹⁹ However, the cause of such escalation would be a nuclear attack against a nuclear-armed state; the target's incorrect assessment, prior to detonation, that the attack was nonnuclear would be unlikely to add much to the danger.

Third, pre-launch ambiguity could be escalatory in more contexts than post-launch ambiguity. Russia and the United States are the only nuclear-armed states that have the equipment and procedures necessary for enabling their leaders to order a nuclear counterstrike before incoming warheads have detonated, though China may be moving in this direction.²⁰ Post-launch

ambiguity, therefore, could spark escalation only in a conflict involving the United States or Russia.²¹ By contrast, before launch, ambiguous delivery systems deployed for prolonged periods may be detectable with even the relatively basic intelligence, surveillance, and reconnaissance (ISR) technologies that are accessible to all nuclear-armed states.²² North Korea, for example, has air-defense radars that can detect U.S. dual-use aircraft on its periphery (especially if the United States wants them to be detected for signaling purposes). Thus, even though this report focuses on potential U.S.-Russian and U.S.-Chinese conflicts, the risks of escalation exist in other contexts, too—in particular, conflicts involving India and Pakistan, North Korea and the United States, or Russia and France, most likely fighting as part of the North Atlantic Treaty Organization (NATO).

While the debate about post-launch ambiguity has been raging, potential causes, types, and consequences of pre-launch ambiguity have been largely ignored.

CHAPTER 3

THE EVOLUTION OF AMBIGUOUS WEAPONS

Not all ambiguous delivery systems are relevant to pre-launch warhead ambiguity. In fact, some of the weapon types most discussed in relation to post-launch ambiguity—air-launched cruise missiles, in particular—are largely irrelevant to pre-launch ambiguity because they are difficult to observe directly at that point. But the ambiguous platforms that carry them may be visible. Aircraft and ground-launched cruise and ballistic missiles, therefore, are most salient to an analysis of the risks of pre-launch ambiguity.

Pre-launch ambiguity can also be associated with surface ships and, if they can be tracked, submarines. This report's scope does not permit detailed consideration of naval platforms, which have very different operational practices from those of aircraft and ground-launched missiles. Note, however, that if a single ship or submarine is used to carry both nuclear and conventional weapons, acute and probably irresolvable ambiguity could result.

Neither the People's Liberation Army (PLA) Navy nor the U.S. Navy currently deploys vessels that carry both nuclear and nonnuclear weapons (except for the nonnuclear torpedoes that U.S. and presumably Chinese ballistic missile submarines [SSBNs] carry for self-defense).²³ By contrast, the Russian Navy deploys nuclear- and conventionally armed cruise missiles on attack submarines and a range of nuclear and nonnuclear weapons on surface ships.²⁴ Reflecting the ambiguity inherent in this posture, the U.S. Defense Intelligence Agency stated, in 2017, that Russia's "Baltic fleet presents a significant long-range precision conventional and theater nuclear strike threat to Western Europe."²⁵ (There is no technical reason why a single aircraft or multiple-warhead missile could not carry both nuclear and nonnuclear munitions, as Russian ships do, but none appear to have been used in this way, with the exception of conventional armaments on nuclear-armed aircraft for self-defense.)

DUAL-USE AIRCRAFT

Dual-use aircraft are as old as the nuclear age. The first nuclear-weapon delivery system—the B-29 bomber, which was used to drop nuclear weapons on Hiroshima and Nagasaki in World War II—was designed and originally used exclusively for carrying conventional bombs. Today, all U.S. aircraft qualified to deliver nuclear weapons are also assigned a conventional role, as are all the NATO aircraft with a role in delivering U.S. nuclear weapons (see table 2).²⁶ (In fact, the B-58, retired in 1970, appears to be the only U.S. aircraft that never had a conventional role.)²⁷

Similarly, no contemporary Russian aircraft are used exclusively for nuclear operations.²⁸ While dual-use Russian aircraft have long been armed with cruise missiles or gravity bombs, Russia has recently developed an air-launched IRBM, Kinzhal, that Russian President Vladimir Putin has stated can carry a nuclear or nonnuclear warhead.²⁹

Prior to China's acquisition of a substantial ballistic missile force in the 1970s, the United States believed that Beijing's primary delivery system for nuclear weapons was dual-use aircraft—initially the Soviet-produced Tu-16 and subsequently the Chinese-manufactured H-6. These were probably the only Chinese aircraft to have ever been assigned a nuclear role.³⁰ Once China had built up its missile forces, that role became marginal and perhaps even nonexistent. According to a 2019 Pentagon assessment, however, “[s]ince at least 2016, Chinese media have been referring to the H-6K [the latest H-6 variant] as a dual nuclear-conventional bomber,” suggesting that this aircraft's nuclear role may have been revived.³¹






















AMBIGUOUS MISSILES

Ambiguous ground-launched ballistic and cruise missiles represent a more dynamic area of technology. The history of these missiles is instructive because it suggests what their future may be. Such missiles were relatively unimportant throughout much of the Cold War—first because of technological limitations and later because of treaty limitations. As these limitations have progressively been lifted, and as China has emerged as a strategic competitor to the United States, the capabilities and importance of ambiguous Chinese and Russian ground-launched cruise and ballistic missiles have increased. This trend appears set to continue.

Starting in the mid-1950s, the Soviet Union and the United States deployed dual-use ground-launched ballistic missiles with ranges of up to a few hundred kilometers (see figure 1). Given accuracy limitations, however, the military utility of early ballistic missiles armed with high explosive warheads would have been marginal at best. For example, the accuracy of the

TABLE 2

Contemporary Ambiguous Chinese, Russian, and U.S./NATO Aircraft and Ground-Launched Missiles³²

	China	Russia ^a		United States/NATO	
Heavy bombers	 H-6K	 Bear-H6/H16 (Tu-95 MS6/MS16)	 Blackjack (Tu-160)	 B-2	 B-52H
Other aircraft^b		 Backfire-C (Tu-22M3)	 Fencer-D (Su-24M)	 F-15E	 F-16
		 Foxhound (MiG-31K)	 Fullback (Su-34)	 PA-200 Tornado	
Ground-launched ballistic and boost-glide missiles	 DF-17 ^{c,?}	 SS-21 Scarab (Tochka/Tochka-U)	 SS-26 Stone (Iskander-M)		
	 DF-21 ^d				
	 DF-26				
Ground-launched cruise missiles^b		 SSC-1B Sepal (P-10 Progress) ^e	 SSC-5 Stoooge (3M55) ^{f,?}		
		 SSC-7 (9M728) [?]	 SSC-8 (9M729)		

? It is unclear whether this weapon is dual-use.

a There is significant uncertainty about Russian capabilities, in particular, and this accounting may be incorrect or incomplete.

b A 2012 study by Igor Sutyagin (see note 32) indicates that nuclear warheads are available for MiG-25RB/MiG-25BM aircraft and SSC-3 missiles (4K40 and 4K51 Rubezh). These systems are not included as their current deployment status is unclear and other sources do not include them in lists of Russian systems with a nuclear role.

c It is unclear whether this weapon has been deployed yet.

d This missile has separate nuclear and nonnuclear variants.

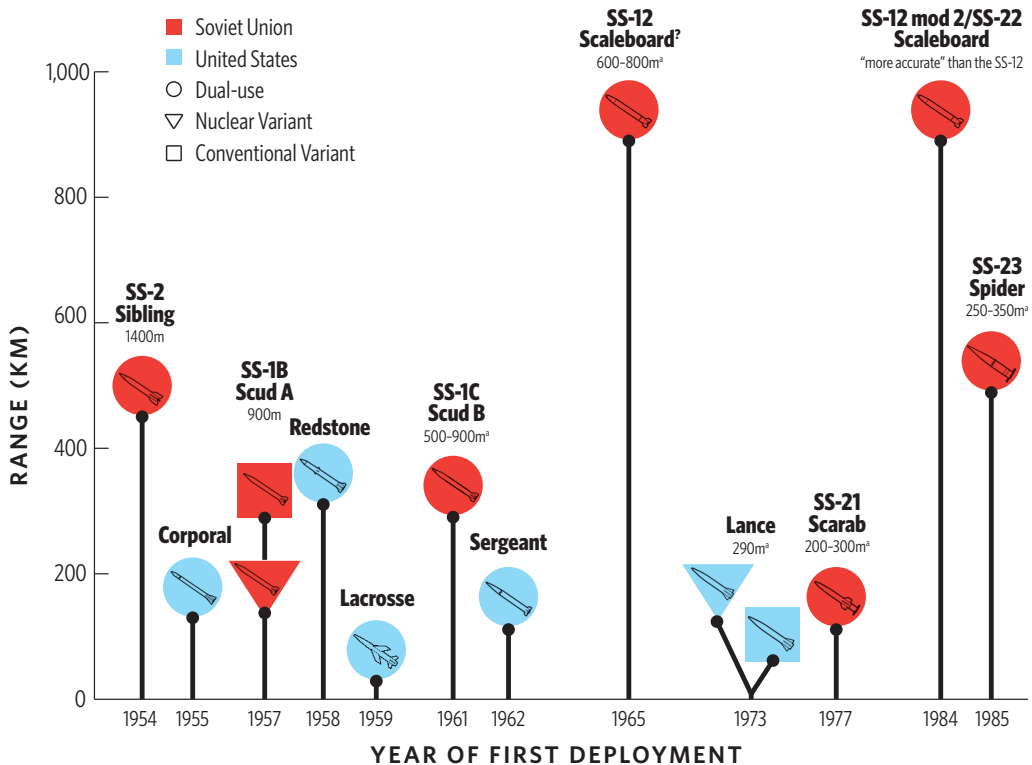
e Sources differ as to the precise Russian designation of this missile. Sutyagin suggests this designation as part of the 4K44 Redut coastal defense system.

f This missile is deployed in various basing modes. On land, it is deployed as part of the K-300P Bastion-P coastal defense system.

Soviet SS-1B missile was estimated in a 1961 U.S. National Intelligence Estimate to be 900 meters (0.6 miles).³³ To put this figure in context, if such a missile were fired against a building the size of the Pentagon—a huge facility by the standards of military targets—the probability of a direct hit would be a mere 5 percent or so.³⁴ Moreover, the accuracy of ballistic missiles degrades as their range increases. For this reason, weapons with ranges beyond a few hundred kilometers were exclusively nuclear-armed early in the Cold War.³⁵

FIGURE 1

Dual-Use Soviet and U.S. Ground-Launched Ballistic Missiles Deployed During the Cold War



Where available, accuracy (circular error probable) is shown in meters (m). The accuracy of a missile generally depends on the distance over which it is fired. Some sources, however, do not state the firing distance corresponding to the given accuracy.

? Unclear whether this weapon was dual-use.

a When fired to two-thirds range (which is taken as 125 km for the Lance missile).

Sources: Director of Central Intelligence, *Soviet Technical Capabilities in Guided Missiles and Space Vehicles*, National Intelligence Estimate 11-5-61, April 25, 1961, Table IV, https://www.cia.gov/library/readingroom/docs/DOC_0000278407.pdf; Central Intelligence Agency, Office of Current Intelligence, "The SS-12," Intelligence Memorandum, December 30, 1965, 1, RDP79T00472A000600060002, CREST System, <https://www.cia.gov/library/readingroom/docs/CIA-RDP79T00472A000600060002-8.pdf>; Director of Central Intelligence, *Warsaw Pact Theater Forces—1985*, Interagency Intelligence Memorandum, NI IIM 85-100006, September 1985, 5-7, RDP-88T00565R000200250002, Crest System, <https://www.cia.gov/library/readingroom/docs/CIA-RDP88T00565R000200250002-1.pdf>; *Soviet Military Power 1985* (Washington, DC: U.S. Government Printing Office, April 1985), 38; *Soviet Military Power 1987* (Washington, DC: U.S. Government Printing Office, March 1987), 41-42 and 74; U.S. Army Aviation and Missile Life Cycle Management Command, "Missilery," <https://history.redstone.army.mil/miss.html>; and White Sands Missile Range Museum, "White Sands Missile Range Missile Park," <http://www.wsmr-history.org/missilepark.htm>. There are various small discrepancies between sources.

In the 1970s and 1980s, the Soviet Union and the United States capitalized on improved technology to deploy more accurate dual-use ballistic missiles. These weapons included the Soviet SS-12 Mod 2, which was first deployed in about 1984 and had a range of 900 kilometers (560 miles), making it the longest-range dual-use missile from the Cold War.³⁶ The United States did not deploy a dual-use missile with a range beyond a few hundred kilometers, but, in the late 1970s, it seriously considered doing so.³⁷

It is not difficult to imagine that, as the 1980s had progressed, Moscow and Washington could have deployed dual-use ground-launched ballistic missiles of increasingly long ranges. Moreover, during the same time period, cruise missiles were becoming more accurate and hence able to deliver nonnuclear warheads effectively, potentially enabling deployments of dual-use ground-launched cruise missiles. Both developments were forestalled by the INF Treaty, which prohibited all ground-launched ballistic and cruise missiles with ranges between 500 and 5,500 kilometers (310 to 3,400 miles). Although the treaty was negotiated to rein in nuclear capabilities, its limits also applied to conventionally armed missiles and led to the elimination of SS-12 Mod 2 missiles, among others. Moreover, two years later, the Cold War ended and the United States stepped away from dual-use ballistic missiles entirely, dismantling the Lance missile even though it was not legally required to do so.

China, however, was not a party to the INF Treaty and has invested heavily in ambiguous missiles.

China, however, was not a party to the INF Treaty and has invested heavily in ambiguous missiles. It currently fields two nuclear-armed variants and two conventionally armed variants of its medium-range DF-21 ballistic missile (see box 1).³⁸ In addition, China has now deployed one or two true dual-use missiles. In 2016, it started to field the DF-26, an IRBM that authoritative Chinese sources, as well as the Pentagon, state can accommodate a nuclear or nonnuclear warhead.³⁹ Then, in an October 2019 military parade, Beijing exhibited a ground-launched hypersonic boost-glide weapon, the DF-17, implying that it had already deployed this missile or would do so shortly. According to reliable media reporting, the U.S. intelligence community (or at least parts of it) assesses that the DF-17 is dual-use.⁴⁰

BOX 1

China's Ambiguous DF-21 Missiles

China appears to deploy four versions of its DF-21 medium-range ballistic missile. Two variants, the land-attack DF-21C and antiship DF-21D, are conventionally armed. The other two are nuclear-armed: the DF-21A and a variant referenced by the U.S. Department of Defense as the CSS-5 Mod 6, whose Chinese designation is not yet publicly known (though it is sometimes listed as the DF-21E in nongovernmental English-language sources).⁴¹

The two conventional variants are very similar, if not identical, to one another but differ in several significant ways from the nuclear-armed DF-21A (see adjacent figure).⁴² Because these differences are observable in satellite imagery, U.S. analysts should have little difficulty distinguishing between DF-21A and DF-21C/D missiles, even if such missiles were collocated—assuming, that is, that U.S. ISR capabilities are functioning normally and that China has not engaged in deception.

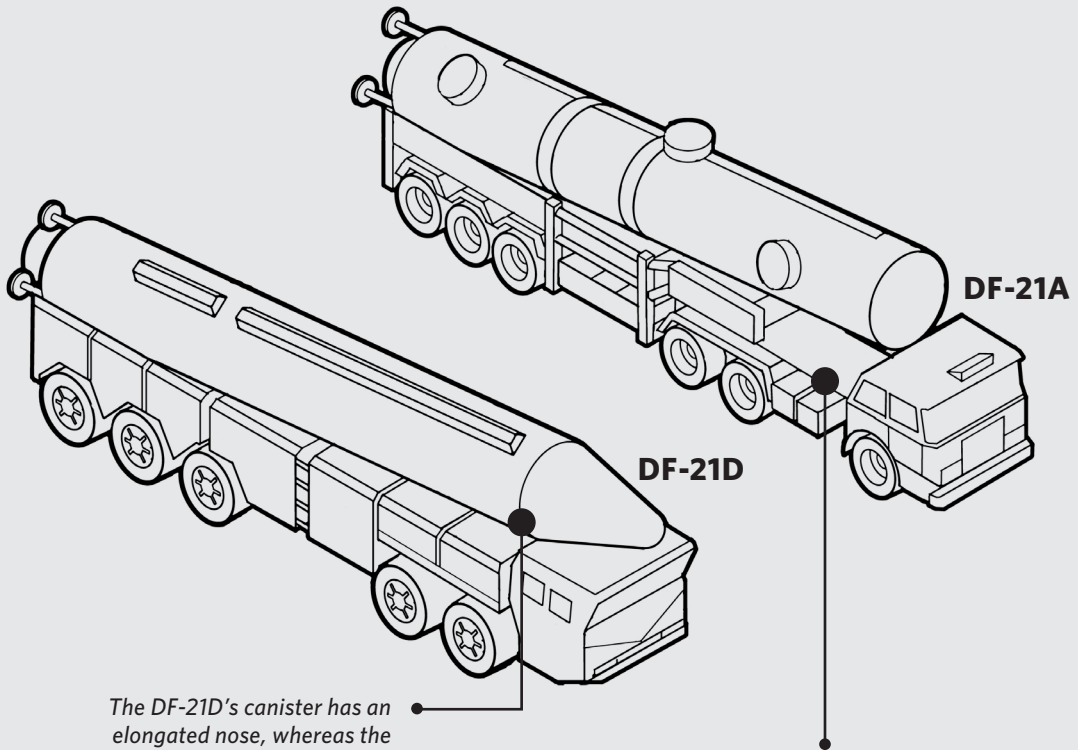
Little is known publicly about the design of the nuclear-armed CSS-5 Mod 6, which was first deployed in about 2015 or 2016. But this weapon could have important implications for the risks of pre-launch warhead ambiguity.⁴³ Specifically, if the missile and its TEL are similar or identical to the DF-21C/D and its TEL, then its deployment probably increases the likelihood of mischaracterization or uncertainty. If, however, this system is observably different from the DF-21 C/D, then its deployment probably does not exacerbate the escalation risks.

Russia, meanwhile, has continued to field and enhance a force of dual-use ground-launched missiles. This force is highly opaque (and the accounting provided in table 2 may well be incomplete or inaccurate). Most of these weapons have ranges of less than 500 kilometers (310 miles) and were, therefore, not limited by the INF Treaty. But the United States claims that a new ground-launched cruise missile, the SSC-8 (often referred to by its Russian designation of 9M729), is dual-use and has a range of “well over” 500 kilometers.⁴⁴ Russian insistence that the missile is treaty-compliant, which seems implausible, did not stop the United States from withdrawing from the INF Treaty in 2019.

With the treaty's collapse, both Moscow and Washington have indicated that they are now developing ground-launched missiles with ranges longer than 500 kilometers. Only Russia,

Schematic drawing of the DF-21A and DF-21D missile systems.

The missiles themselves, which are stored inside the canisters, are not visible. The DF-21C is not shown because its TEL and canister are identical or nearly identical to the DF-21D's.



The DF-21D's canister has an elongated nose, whereas the DF-21A's canister is flat-topped.

The DF-21A's TEL is a two-piece tractor-trailer, whereas the DF-21D's TEL has a nonarticulated chassis.

however, is likely to deploy dual-use systems (the United States will almost certainly focus on conventional systems, not least because the politics of basing nuclear-armed mobile missiles on an ally's territory would be fraught). Immediately after Washington gave notice of its withdrawal from the treaty, Moscow outlined, in general terms, its military response. Putin ordered the development of a ground-launched variant of the Kalibr sea-launched cruise missile—which is, in fact, precisely what the SSC-8 is believed to be—and a ground-launched, intermediate-range hypersonic weapon.⁴⁵ Separately, Defense Minister Sergei Shoigu announced that Russia would also extend the ranges of other weapons under development.⁴⁶ No details about any of these systems—including how they will be armed—have been released. But it seems likely that Russia will deploy ground-launched missiles of increasingly long ranges and that at least some of them will be dual-use.

LOOKING FORWARD

Other possible developments are not directly related to the INF Treaty's demise. The U.S. Department of Defense, for example, has indicated that it seeks to reacquire a nuclear-armed sea-launched cruise missile. Even if this weapon is not dual-use, its deployment will still reintroduce ambiguity to U.S. naval forces because it will almost certainly be deployed on platforms—attack submarines or surface ships—that do not currently carry nuclear weapons.

Russia and, less likely, the United States could also develop ambiguous intercontinental missiles; in particular, they could use a booster for an intercontinental ballistic missile (ICBM) or sea-launched ballistic missile (SLBM) to launch a maneuverable reentry vehicle—that is, one with the capability to steer after it reenters the atmosphere. Ambiguity could arise in two ways.⁴⁷ The reentry vehicle itself could be dual-use, like the one on Russia's Kinzhal missile.⁴⁸ Alternatively, the reentry vehicle could carry only nonnuclear warheads but be launched by an ICBM or SLBM that was also deployed with nuclear warheads. The administration of then president George W. Bush tried to pursue this approach with the Conventional Trident Modification, a program to replace some nuclear warheads on Trident D5 SLBMs with nonnuclear weapons (this effort was eventually abandoned after Congress declined to fund it, in part because of the risks associated with post-launch ambiguity).⁴⁹

China may have similar ambitions. It could build upon its deployment of the DF-21, DF-26, and DF-17 missiles by fielding ambiguous missiles of even longer ranges, including perhaps intercontinental-class weapons. Meanwhile, over the next decade or so, China may significantly enhance its air force's role in nuclear operations. It is developing a new stealth bomber, which Chinese sources indicate will be dual-use, and an air-launched ballistic missile, which the Pentagon assesses “may include a nuclear payload.”⁵⁰

Finally, China, Russia, and the United States are not the only states to possess ambiguous weapons. Other nuclear-armed states do, too, and such weapons could create escalation pressures, particularly in a conflict between France (most likely fighting as a part of NATO) and Russia, or India and Pakistan, or North Korea and the United States (see appendix).

WHY WARHEAD AMBIGUITY CAN CAUSE MISCHARACTERIZATION PRE-LAUNCH

Mischaracterization or uncertainty could be an intentional or unintentional consequence of warhead ambiguity. If a state wanted an adversary to mischaracterize certain ambiguous weapons, it could try to create misinformation by, for example, issuing misleading communications through either public statements or private messages intended to be intercepted. Alternatively, it could engage in deceptive operational practices. For example, a state could accompany conventionally armed delivery vehicles with communication or security equipment typically associated with nuclear-armed systems. Such misinformation techniques would not be guaranteed to succeed, of course. But if the adversary found it difficult to distinguish between nuclear and nonnuclear weapons in any case, adding misinformation would make characterization even more difficult. For this reason, this chapter focuses on the plausibility of mischaracterization or uncertainty occurring unintentionally.

Incorrect or uncertain conclusions about how a weapon is armed can arise unintentionally in at least two ways. First, while collecting and analyzing intelligence, analysts may misinterpret the inevitably imperfect information that is available to them—a process that is probably equally likely to generate false positives and false negatives. Second, if analysts are unable to draw firm conclusions, national and

If analysts are unable to draw firm conclusions, national and military leaders may assume, for various reasons, that ambiguous weapons are nuclear-armed—a process that sometimes yields false positives.

military leaders may assume, for various reasons, that ambiguous weapons are nuclear-armed—a process that sometimes yields false positives.

INTELLIGENCE COLLECTION AND ANALYSIS

Design assessments. Analysts can mischaracterize or be unable to characterize a delivery system if they make use of incorrect or uncertain assessments about its design—in particular, about whether nuclear warheads, conventional warheads, or both have been produced for it. The biggest contemporary challenge is probably determining whether a delivery system clearly designed to accommodate a nonnuclear warhead also has a nuclear role. Recent public U.S. assessments about some foreign delivery systems, such as Russia’s SSC-5 cruise missile, indicate uncertainty on exactly this point.⁵¹ In a similar vein, a series of official U.S. assessments from the past decade present contradictory assessments about whether various Chinese air-, ground-, and sea-launched cruise missiles are dual-use or equipped only with conventional warheads.⁵²

Uncertainty—and even errors—in design assessments should not be surprising. In practice, indicators that a conventional delivery system is also available for nuclear operations are unlikely to be easily detectable. States have not tested delivery systems with live nuclear warheads for decades. Moreover, in peacetime, it appears that Chinese, Russian, and U.S. dual-use delivery systems are never loaded with nuclear warheads, which are often stored at entirely separate locations. In theory, a state could discover that an opponent had developed a nuclear warhead for some particular delivery system or that specialized troops had practiced loading weapons of that kind with mock nuclear warheads. In practice, obtaining such evidence would require the kind of deep insight into sensitive (and presumably well-protected) activities that may be available only rarely.

Superficially similar delivery systems. Even if design assessments for an adversary’s various delivery systems are accurate, analysts may be unable to distinguish between different weapon types after deployment. The U.S. government, for example, has publicly assessed whether each Chinese DF-21 variant is nuclear or conventional. Especially in a crisis or conflict, however, the United States might mistake those superficially similar weapons by misidentifying, say, a conventionally armed DF-21 as its nuclear-armed variant.

In fact, distinguishing between superficially similar delivery systems has sometimes proved to be difficult even outside of a crisis or conflict. The sale of Soviet MiG-23 aircraft to Cuba in the late 1970s exemplifies the challenges. In 1978, U.S. surveillance flights over Cuba failed to establish whether the aircraft in question were MiG-23Fs (known to the Soviet Union as MiG-23BNs) or MiG-23Ds (also known as MiG-27s).⁵³ The former were widely

exported and used exclusively for conventional operations; the latter were deployed, at that time, only by Soviet forces and had a nuclear role. Key differences between these models, including certain engine parts and components for carrying weapons, would not have been visible from aerial photography.⁵⁴

Even though this incident occurred in peacetime, the resulting uncertainty sparked high-level concern within the U.S. government. A Special Coordination Committee, involving secretary of defense Harold Brown and national security adviser Zbigniew Brzezinski, was created to formulate a response. On November 14, 1978, this committee concluded that, although the introduction of either version would contravene a 1962 Soviet commitment not to deploy “offensive” weapons in Cuba, “[t]he [MiG-23D] represents an additional issue” because of “its nuclear capability and previous deployment only with Soviet forces.”⁵⁵ Two days later, secretary of state Cyrus Vance delivered a formal demarche on the subject to Soviet ambassador Anatoly Dobrynin. Vance went beyond his formal talking points, which expressed equal opposition to both variants, and, in an apparent reference to the possibility that MiG-23Ds had been transferred, expressed particular “concern about the possible presence of ground attack aircraft which we regarded [sic] as offensive.”⁵⁶

The ambiguity was not clarified until February 1979. Likely acting on Soviet instructions, Cuba published, in the official magazine of its armed forces, high-quality photographs of the aircraft, which the Central Intelligence Agency (CIA) determined were “clearly” MiG-23Fs.⁵⁷ Assistance from the state responsible for a deployment may not always be so forthcoming in the future—especially during a crisis or conflict, when ambiguity might need to be resolved in hours or days, rather than months, to avert escalation.

Dual-use delivery systems. Systems designed to be dual-use, such as the SSC-8, create another layer of complexity and a particular risk of mischaracterization or uncertainty. Conclusive characterization generally requires identifying whether nuclear warheads are physically attached to delivery systems. Even the presence of nuclear warheads available for loading at short notice is not conclusive unless nonnuclear warheads are known not to be available.

Warheads, however, are difficult to detect. They are small; can be transported relatively secretly (at least when compared to many delivery systems); and are usually concealed within delivery systems, storage bunkers, or transportation systems. These characteristics complicate intelligence collection, particularly overhead imagery. Consequently, definitive evidence of the presence of nuclear warheads—from communications intercepts or human intelligence, perhaps—may not always be available. In this case, troops who have received specialized training or equipment and facilities typically associated with nuclear warheads can be useful heuristics but do not prove that nuclear warheads are present because they are also consistent with plans to deploy warheads at short notice.

These challenges are illustrated by contemporary efforts to characterize Russian forces in Kaliningrad. Various dual-use Russian delivery systems, including aircraft, short-range ballistic missiles, and coastal defense cruise missiles, are based in the enclave. From the early 2000s onward, senior officials in NATO member states have openly claimed, and unnamed intelligence officials have periodically told journalists, that Russia has deployed nuclear weapons there.⁵⁸ Yet it is often unclear whether these statements are references to dual-use delivery systems or actual nuclear warheads. Satellite imagery tells a similarly ambiguous tale. One military facility in Kaliningrad appears suitable for storing nuclear warheads, given its security features, such as partially buried bunkers surrounded by triple fencing.⁵⁹ Moreover, Russia has undertaken extensive recent renovation efforts. Yet, as the U.S. analyst Hans Kristensen notes, the existence of these upgraded facilities “does not provide conclusive answers” to questions about the presence of nuclear warheads.⁶⁰ Just because Russia has the capability to store warheads in Kaliningrad does not mean that it is doing so or has decided to do so. Instead, Russia may want the ability to rapidly deploy warheads to Kaliningrad in a crisis or conflict.

NATO governments, of course, may have additional sources of information to help resolve this issue. Yet, even if they are certain that nuclear warheads are not present in Kaliningrad today, ambiguity could easily reemerge in a crisis or conflict. In this case, the fog of war, coupled with Russian efforts to conceal the movement of its forces, could prevent NATO from clearly determining whether nuclear warheads had been moved to the enclave.

Extrapolation. A particular challenge can arise if both nuclear and nonnuclear versions of the same ambiguous delivery system are deployed simultaneously. In such cases, if analysts identify only one version, they may incorrectly conclude that all the weapons are armed in the same way. Such extrapolation can result in false positives or false negatives. While the underlying logic may seem obviously flawed, extrapolation is often inevitable because intelligence information is often incomplete.

Theoretically, errors created by extrapolation could be identified as more information became available. In practice, however, unless analysts realized that their conclusions might be wrong and requested more information, intelligence collection on the ambiguous missiles might be curtailed. Moreover, even if contradictory evidence did emerge, at least two psychological biases might prevent analysts from revising their conclusions.

First, people have a well-documented tendency, known as confirmation bias, to interpret new information as being consistent (or at least not inconsistent) with the expectations created by preexisting beliefs.⁶¹ In the intelligence world, analysts can ignore new information because their preconceptions prevent them from understanding its significance. In 1962,

for example, U.S. analysts were not expecting the Soviet Union to ship missiles to Cuba, and, as a result, they ignored reports about two unusual cargo ships bound for the island. These ships had “exceptionally large hatches” but also were riding high in the water, implying that they carried “cargo of low weight and high volume,” such as ballistic missiles.⁶² Similarly, after identifying one variant of an ambiguous weapon, analysts might ignore new information that suggested the presence of a second variant.

Second, in making estimates, people tend to anchor—that is, they give undue weight to the first piece of information encountered and thus make insufficient revisions as new information emerges.⁶³

Anchoring can help explain, for instance, the United States’ persistent and incorrect belief, in the late 1950s and early 1960s,

that the Soviet Union had much greater ICBM production capabilities than the United States. For various reasons, initial estimates greatly exaggerated Soviet capabilities. Because subsequent estimates were formulated as revisions to previous ones, the U.S. intelligence community—Air Force intelligence staff, in particular—continued to assert the existence of the so-called missile gap long after the totality of the evidence suggested otherwise.⁶⁴ Similarly, even if analysts recognize new evidence that calls into question their initial hypothesis about the type of armament on some ambiguous delivery vehicle, they may give that evidence insufficient weight.

In the run-up to the Cuban Missile Crisis, the CIA misidentified nuclear-armed cruise missiles as conventionally armed ones. Shortly before the crisis, the Soviet Union delivered two different types of missiles to Cuba for coastal defense and for targeting the U.S. naval base at Guantánamo Bay: conventionally armed SSC-2B missiles (or Sopka in Soviet terminology) and nuclear-armed SSC-2A missiles (Frontonvye Krylatye Rakety-1), along with about eighty nuclear warheads. Although SSC-2A and SSC-2B missiles had some differences in their guidance systems, launchers, and support equipment, they were based on the same weapon, the AS-1 air-to-surface missile, and had nearly identical airframes.⁶⁵ Using photographs obtained from U-2 surveillance aircraft, U.S. intelligence analysts correctly identified operational conventionally armed SSC-2B missiles at four sites. The nuclear-armed SSC-2A missiles, however, were still crated at this time, preventing the collection of detailed intelligence about them and leading analysts to extrapolate and misidentify them as yet more SSC-2Bs.⁶⁶ The historians Ernest May and Philip Zelikow have concluded that, as a result, the United States “did not know and never seriously imagined that the coastal defense cruise missiles were deployed with nuclear warheads.”⁶⁷

If analysts identify only one version of an ambitious delivery system, they may incorrectly conclude that all the weapons are armed in the same way.

Crisis and wartime complications: U.S. and Russian forces. Intelligence-collection capabilities have improved enormously since the Cuban Missile Crisis and by almost as much since the Soviet Union sold MiG-23s to Cuba in the late 1970s. These improvements, which include more capable remote-sensing technology and the advent of espionage in cyberspace, could help mitigate the effects of warhead ambiguity. In assessing modern intelligence-collection techniques, however, the real question is not how they perform in peacetime but how they would perform during the confusion of a crisis or, especially, a contemporary conventional conflict. In such contingencies, nuclear and nonnuclear weapons would be more entangled and the consequences of mischaracterization would be more serious.

All dual-use U.S. aircraft are available for both nuclear and nonnuclear operations; they are not grouped, geographically or organizationally, according to function. Likewise, Russia appears to group few, if any, of its ambiguous aircraft and ground-launched missiles functionally.⁶⁸ But while the entanglement of these delivery systems in any context increases the likelihood of an adversary's mischaracterizing them, in peacetime, that likelihood is very low. Since 1968, the United States has followed a policy of not flying live nuclear warheads on combat aircraft outside of a crisis or conflict.⁶⁹ Russia is reported to have a similar policy in place.⁷⁰ Moreover, as recently as 2015, the Russian government stated that all of its "non-strategic nuclear weapons" were "non-deployed" and located in "centralized storage depots."⁷¹ These policies help reduce the likelihood of a nonnuclear delivery system being mistaken for a nuclear one, even if they were adopted to help prevent nuclear accidents and enhance physical security. Indeed, these policies—especially the prohibition on loading combat aircraft with nuclear weapons—are highly credible precisely because they have such sensible motivations.⁷²

Russia and the United States might attack each other's ISR assets as a way of undermining the other's ability to fight a conventional war. Such attacks could make the characterization of ambiguous delivery systems even more difficult.

In a crisis or conflict, however, mischaracterization due to entanglement would become more likely. Nuclear warheads might be loaded onto ambiguous delivery vehicles. In theory, the observing state could determine how individual aircraft or missiles were armed by identifying whether they had been loaded from a storage facility for nuclear warheads or one for nonnuclear munitions. In practice,

amid the fog of war, making such a determination could be very difficult, if not impossible. Moreover, Russia and the United States might attack each other's ISR assets as a way of undermining the other's ability to fight a conventional war.⁷³ Such attacks could make the characterization of ambiguous delivery systems even more difficult.

Further exacerbating the challenges, nuclear operations would likely be conducted alongside nonnuclear ones. As a result, delivery systems carrying nuclear warheads might

be operating nearby identical, or nearly identical, delivery systems that were conventionally armed. While there could be some indicators that a delivery system was nuclear-armed (such as the presence of escort vehicles), the most reliable way to determine its warhead type would be to track each delivery system continuously, from the time it was first loaded with a warhead. But, in practice, this task could prove daunting. Some dual-use U.S. and Russian aircraft are stealthy, and any capability to detect such aircraft at close range would likely be ineffective at greater distances.⁷⁴ Moreover, to ensure its mobile missiles are survivable, Russia would likely try to interfere with the United States' ability to monitor them. Such efforts—for example, the use of camouflage or inflatable decoys—would only need to be partially effective to prevent the United States from tracking each Russian missile continuously.⁷⁵

Crisis and wartime complications: Chinese forces. China's nuclear and nonnuclear forces are less entangled than their U.S. and Russian equivalents on a day-to-day basis. To date, the PLA Rocket Force and its predecessor, the Second Artillery Corps, appear to have operated geographically and organizationally distinct launch brigades for nuclear and conventional missiles.⁷⁶ (Because China is believed to store nuclear warheads and missiles separately in peacetime, missiles that are assigned a nuclear role—that is, “nuclear missiles”—are generally not nuclear-armed prior to a crisis or conflict.) Therefore, if a particular launch brigade undertakes an exercise in peacetime, it should be clear whether its missiles are conventional or nuclear.

In a crisis or conflict, however, China might disperse its conventionally armed and nuclear-armed weapons simultaneously, complicating the task of characterizing them—a concern that the U.S. Department of Defense has recently highlighted.⁷⁷ Characterization would be most challenging if the deployment areas for conventionally armed and nuclear-armed variants of the same missile overlapped. In this regard, the key question is how far missiles might travel from their garrisons while deployed. Open sources do not provide a definitive answer. That said, under the 1991 Strategic Arms Reduction Treaty, Soviet mobile ICBM deployment areas were limited to an area of 125,000 square kilometers (49,000 square miles), which is equivalent to a circle with a radius of 200 kilometers (130 miles).⁷⁸ Presumably, Moscow would not have agreed to this limitation if its plans had called for mobile ICBMs to travel significantly greater distances from their garrisons. If, in a conflict or crisis, Chinese missiles migrated over roughly the same distance, then conventionally and nuclear-armed variants of the same missiles might intermingle if based less than 400 kilometers (250 miles) apart.

According to open-source information, only one pair of brigades—the 611 and 612 brigades, located almost 200 kilometers apart—may meet this criterion today. While reliable information on these units is scant, it is possible (but far from certain) that one operates

nuclear DF-21s and the other conventional DF-21s.⁷⁹ Other pairs of brigades that host nuclear and conventional variants of the same missiles appear to be many hundreds, and more often thousands, of kilometers apart. While this situation could change if China restructures its missile bases, the degree of entanglement within China's missile force would probably be quite limited in a contemporary crisis or conflict—assuming, that is, that Chinese mobile missiles remained within 200 kilometers of their garrisons.⁸⁰

There are reasons to question this assumption though. Chinese missiles travel much farther to conduct exercises.⁸¹ Moreover, *The Science of Second Artillery Campaigns*, a leaked classified textbook from 2004, states that conventional missiles could be transported between theaters in a conflict to where they were needed.⁸² Such “cross-theater maneuvering” could significantly increase the degree of entanglement between China's nuclear and conventional missile forces. Even if China planned to avoid the intermingling of nuclear and conventional missiles in this scenario, the United States would have to be aware of this planning for it to decrease the likelihood of uncertainty or mischaracterization.

Regardless of the distances over which Chinese missiles might migrate, the United States could try to track them continuously, starting from their garrisons, as a way of characterizing them. Other evidence might also be available; some exercises, for example, suggest that missiles and nuclear warheads might be mated in the field (though some analysts believe that mating would likely occur before deployment, most likely in underground facilities for protection).⁸³ If, therefore, a DF-26 missile were to meet up with a vehicle for transporting nuclear warheads, there would be strong grounds for concluding that the missile was nuclear-armed. More speculatively, there may be some differences in the support vehicles for nuclear and conventional launch units.⁸⁴

Looking forward, the characterization challenge will grow if the Rocket Force further entangles its nuclear and nonnuclear missiles.

Yet, in a crisis or conflict, this evidence could be elusive. The PLA Rocket Force would likely try to obscure its operations to enhance the survivability of its missiles. At the very least, it would probably try to conceal its weapons. Indeed, the techniques discussed by the leaked PLA textbook include the use of camouflage and

moving missiles at night, under cloud cover, or during the “blind intervals” of enemy ISR assets (an apparent reference to satellites' periodic coverage).⁸⁵ The Rocket Force might also hide nuclear missiles in tunnels or shelters at various times.⁸⁶

Moreover, China's efforts to protect its missiles might not be limited to such passive measures. *The Science of Second Artillery Campaigns* also discusses various disinformation techniques, including the “feint maneuver” (in which a small force is used to divert attention from a larger one).⁸⁷ Even more significantly, the PLA appears to plan to—and would likely

experience strong pressures to—attack U.S. ISR assets in a conflict, most likely to undermine U.S. conventional operations.⁸⁸ Regardless of Chinese intentions, such attacks would increase the likelihood of the United States’ mischaracterizing, or being unable to characterize, ambiguous Chinese missiles.

Looking forward, the characterization challenge will grow if the Rocket Force further entangles its nuclear and nonnuclear missiles. In the near term, the most likely driver of change is the dual-use DF-26 missile. This missile could be integrated into the Rocket Force in two ways, and it is not yet apparent which approach China is adopting. One option would be to retain the Rocket Force’s existing structure and create separate conventional and nuclear DF-26 brigades.⁸⁹ However, this approach would not leverage the weapon’s “change the warhead, not the missile” feature.⁹⁰ Consequently, it seems possible that China will posture individual DF-26 brigades for both nuclear and conventional operations, making it more difficult to characterize DF-26 missiles. This step could be a harbinger of more widespread restructuring. There may be flexibility and significant cost savings associated with dual-use missile brigades, and if the Rocket Force sets up one and establishes a precedent, internal supporters of separation may find it more difficult to defend their position, potentially resulting in the widespread adoption of dual-use brigades.

INTERPRETATION BY DECISIONMAKERS

Given the challenges of intelligence collection and analysis, assessments about how ambiguous weapons are armed can be inconclusive. Yet, especially in a crisis or conflict, military and national leaders may not fully account for uncertainty for two reasons. First, intelligence analysts may not communicate the full extent of their uncertainty to decisionmakers for fear that it would be unwelcome or reflect badly on their work. Second, even if their uncertainty is properly conveyed, decisionmakers may nonetheless assume that ambiguous delivery vehicles are nuclear-armed. This tendency, to which both military considerations and psychological factors contribute, does not always lead to the wrong conclusion, but when it does, it produces false positives.

In theory, decisionmakers do not need to make assumptions; they could accept the uncertainty and plan on that basis (by, for example, trying to identify a course of action that would produce an acceptable outcome whether or not the weapons in question were nuclear-armed). To help manage the uncertainty, decisionmakers could even try to estimate the probability that the weapons were nuclear-armed. Yet there seem to be few precedents for such behavior (as U.S. experience during the Cuban Missile Crisis, described below, exemplifies) and both military and psychological reasons not to expect it.

In trying to manage a crisis or conflict, decisionmakers inevitably make assumptions, including about their opponents' capabilities and intentions. One driver is the acute need to reduce, to a manageable level, the complexity that is associated with any contingency. A second is people's tendency to seek certainty, even when the evidence is inconclusive. For example, politicians have criticized scientists for giving "wishy-washy, iffy" probabilistic answers to questions about, say, the health effects of sweeteners or pollution instead of providing an unequivocal yes or no.⁹¹

In making assumptions, decisionmakers are likely to—and, indeed, should—consider the risks of being wrong. When warhead ambiguity arises, the costs of a false negative could be high and much greater than those of a false positive. Of course, decisionmakers should recognize that nuclear weapons are generally less likely to be used than conventional weapons, but in a major conflict, when conventional deterrence has already failed, the danger that nuclear deterrence could also fail may seem very real. As a result, it is reasonable, from a military perspective, for decisionmakers to assume that ambiguous weapons are nuclear-armed.

Less rationally, the negativity bias—a psychological effect that leads to “negative events [being] more potent with respect to their objective magnitude than . . . positive events”—may also play a role.⁹² One consequence is that possible negative outcomes exert a disproportionate influence on human behavior (that is, the influence is larger than predicted by a rational cost-benefit analysis). This effect, for example, helps explain why states tend to inflate threats when assessing their severity.⁹³ And in this vein, when ambiguous weapons are deployed, the possibility of their being nuclear-armed may loom even larger in decisionmakers' minds than it should.

Assumptions during the Cuban Missile Crisis. U.S. decisionmakers on ExComm, the Executive Committee of the National Security Council set up to manage the crisis, confronted multiple deployments of ambiguous Soviet weapons. At no time before or during the crisis did the U.S. intelligence community detect any Soviet nuclear warheads in Cuba. Because warheads are easy to conceal, however, the U.S. intelligence community had little confidence that, if warheads were present, it would detect them. Therefore, logically, neither the intelligence community nor the ExComm members took the absence of evidence to be evidence of absence. Yet the decisionmakers went further than simply recognizing that nuclear warheads may have been present; they quickly assumed that warheads were, in fact, available for SS-4 and SS-5 missiles, IL-28 bombers, and MiG-21 fighters. Decisionmakers were fully aware of the lack of evidence supporting their assumptions, especially in the case of the aircraft suggesting that they were deliberately planning for a worst-case scenario.

ExComm members' assumptions about the missiles in Cuba were well-grounded. The CIA had previously assessed that these weapons were deployed exclusively with nuclear warheads.⁹⁴ Echoing his agency's logic, director of central intelligence John McCone explained

to members of Congress, on October 22, 1962, that because SS-4 and SS-5 missiles “are relatively ineffective weapons without nuclear warheads, we think it prudent to assume that nuclear weapons are now or shortly will be available in Cuba.”⁹⁵ The historian David Coleman notes that “policymakers accepted, internalized, and applied this principle” to other systems, even though the logical basis for doing so was significantly weaker in the case of the aircraft.⁹⁶

Prior to the crisis, the U.S. intelligence community had concluded that IL-28 aircraft had the “capability of delivering nuclear weapons,” implying that they could also be used with conventional weapons.⁹⁷ This assessment could have led decisionmakers to be cautious about assuming that the IL-28s deployed to Cuba were nuclear-armed, but they showed no

hesitation to make plans on that basis. At various points during the first week of the crisis, secretary of defense Robert McNamara and chairman of the Joint Chiefs of Staff Maxwell Taylor, as well as Air Force chief of staff Curtis LeMay (who was not on ExComm), opposed U.S. military strikes that were focused solely on Soviet missiles.⁹⁸ Their argument, which was more explicit in some cases than others, was that because aircraft could have similar effects against the United States as the missiles, there was little point taking out the latter but not the former.

The case for the MiG-21s being nuclear-armed was substantially weaker than for the IL-28s. Prior to the crisis, U.S. intelligence analysts were not certain that the MiG-21 had been assigned a nuclear role and assessed that, even if it had been, carrying nuclear weapons would severely limit its range.⁹⁹ In fact, on September 4, 1962, the day before the United States first detected MiG-21s in Cuba, McGeorge Bundy, the national security adviser and future ExComm member, described the arming of this type of aircraft “with jerry-built nuclear weapons” as “not a likely configuration.”¹⁰⁰

During the crisis, no clear evidence emerged about how the MiG-21s were armed, but some ExComm members nonetheless assumed that nuclear warheads were available. The issue arose on the first day of the crisis, October 16, once again in discussions about the targets for possible U.S. airstrikes. McNamara emphasized the threat the MiG-21s posed, arguing that they should be attacked in any military strike. He explicitly recognized the limitations of the available intelligence regarding their armaments but then added that “if there are nuclear warheads associated with the [missile] launchers,” which everyone believed there were or shortly would be, “you must assume there will be nuclear warheads associated with [the] aircraft.”¹⁰¹ Taylor made a similar argument later the same day.¹⁰² However, not all ExComm members shared McNamara and Taylor’s assessment. Most importantly, presi-

Decisionmakers were fully aware of the lack of evidence supporting their assumptions, especially in the case of the aircraft, suggesting that they were deliberately planning for a worst-case scenario.

dent John F. Kennedy argued that the MiG-21s were probably armed with “iron [conventional] bombs . . . because, obviously, why would the Soviets permit nuclear war to begin under that sort of half-assed way?”¹⁰³ That said, given that the secretary of defense and the chairman of the Joint Chiefs of Staff believed the MiG-21s were nuclear-armed, it seems likely that military plans were developed on that basis.

What matters about these assessments is not whether they turned out to be correct (as with the SS-4s, SS-5s, and IL-28s) or incorrect (as McNamara and Taylor were with respect to the MiG-21s). Rather, what matters is that they were assumptions and that the decision-makers who made them did so consciously, knowing that the available intelligence did not support a definitive conclusion about how the IL-28s and MiG-21s, in particular, were armed. A sense of what “prudent” crisis management required shaped the thinking of most ExComm members. Moreover, it is probably not coincidental that McNamara and Taylor, the two ExComm members most responsible for military planning, were the most vocal in urging their colleagues to think in this way. The relative importance of rational military calculations and the negativity bias in shaping these perceptions is, however, unclear.

WHY WARHEAD AMBIGUITY COULD LEAD TO ESCALATION

Uncertainty and mischaracterization could have quite different consequences. Uncertainty among decisionmakers does not necessarily lead them to misperceive an adversary's capabilities or intentions (on the contrary, it suggests a realistic understanding of their state's limited ability to collect and analyze intelligence). Therefore, uncertainty about how a warhead was armed would probably not raise the risk of inadvertent escalation in a crisis or conflict—in fact, it might even enhance deterrence and make deliberate escalation less probable (see box 2).

Unfortunately, mischaracterization is significantly more likely to occur than uncertainty because of the tendency among decisionmakers to assume, without clear evidence to the contrary, that ambiguous weapons are nuclear-armed.

In a crisis or conflict, mischaracterization—whether a false positive or a false negative—could increase the likelihood of escalation in two ways: First, and perhaps more importantly, one state might misread the other's intentions regarding the use of nuclear weapons. Second, one state might wrongly assess the other's military capabilities. This section focuses on inadvertent escalation, which could occur if the mischaracterization were an unintentional consequence of ambiguity. States might seek to induce uncertainty or mischaracterization deliberately to try to enhance deterrence—though doing so would not be risk-free (see box 3).

BOX 2

Warhead Ambiguity and Psychological Ambiguity

Most decisionmakers are likely to assume, in the absence of clear evidence to the contrary, that ambiguous weapons are nuclear-armed. A few, however, may accept uncertainty and plan on that basis. Such decisionmakers probably find themselves in a condition of psychological ambiguity—a concept that, confusingly, is different from warhead ambiguity but nonetheless relevant.

Psychologists distinguish between two types of uncertainty: risk and ambiguity. A risky situation is one in which the probabilities of the various possible outcomes are known (such as a gambling game that involves choosing a ball from an urn containing equal numbers of red and black balls). By contrast, ambiguity arises when the probabilities of those outcomes are unknown (for example, a game in which the player is not told the ratio of red to black balls). People tend to have an aversion to ambiguity (though the experimental evidence is not definitive).¹⁰⁴ Thus, they are generally willing to accept smaller gains to avoid being placed in an ambiguous situation.

If intelligence analysts are unable to characterize an adversary's weapons because of warhead ambiguity, decisionmakers are likely to find themselves in a psychologically ambiguous situation. After all, estimating probabilities would be inherently challenging (and few people voluntarily try to assign explicit probabilities in this way). In such cases, ambiguity aversion could manifest itself as enhanced deterrence. So, for example, if U.S. intelligence analysts were unable to characterize some threatening Chinese mobile missiles, ambiguity aversion might reduce the likelihood that U.S. leaders would decide to attack the missiles (compared to a risky situation in which the analysts estimated the probability that the missiles were conventionally armed). That said, if other options for combating the threat (such as relying on missile defense) also presented ambiguities, ambiguity aversion might not have any net effect.

ASSESSING INTENT

In any conflict between two nuclear-armed states, the risk of inadvertent escalation would be increased if either one misjudged the likelihood of its opponent's using nuclear weapons. Indeed, to avoid this kind of misperception, a belligerent considering nuclear use might attempt to signal its resolve first by, for example, dispersing nuclear-armed delivery vehicles in the hope that its adversary would back down or, at least, reach some kind of accommodation.

Warhead ambiguity could obfuscate such signaling operations and increase the already significant challenges of communicating and assessing intent. False negatives could lead to an intended signal being missed. False positives could lead a state to wrongly believe that its adversary was issuing a signal or even secretly preparing for nuclear use.

False negatives. A nuclear signal might be missed if it was sent using ambiguous delivery systems that the intended recipient wrongly concluded were conventionally armed. Signaling is a part of both the United States' and China's defense doctrines. The 2018 U.S. Nuclear Posture Review, for example, states that U.S. nuclear forces must have "the capacity to display national will and capabilities as desired for signaling purposes throughout crisis and conflict."¹⁰⁵ Chinese doctrine, meanwhile, embraces an apparently similar concept, termed "campaign deterrence," involving nuclear or nonnuclear missile operations to "display the possession of the capacity to deliver inexorable, unstoppable, disproportionate force."¹⁰⁶ Official and unofficial Russian sources, by contrast, have been largely silent on signaling. However, in a 2015 interview, Putin stated that he had been ready to place Russian nuclear forces on combat alert if the 2014 operation to annex Crimea had run into trouble.¹⁰⁷ This acknowledgment suggests that Moscow also plans to signal prior to nuclear use.

Even without warhead ambiguity, nuclear signaling can be challenging. Nuclear signals have frequently failed to achieve their purpose—sometimes because they did not attract the attention of the adversary. During the Berlin Crisis of 1958–1959, for instance, president Dwight Eisenhower and other U.S. principals were likely unaware that the Soviet Union had deployed nuclear-armed SS-3 missiles to East Germany to try to signal Moscow's willingness to risk nuclear war if Washington did not concede to the Kremlin's demands over the status of Berlin.¹⁰⁸ The Soviet Union may have issued other nuclear signals—including one related to the invasion of Czechoslovakia in 1968—that the United States simply missed.¹⁰⁹ Subsequent improvements in ISR capabilities notwithstanding, the fog of war in an actual conflict between the United States and Russia or China could still create real challenges for detecting nuclear signals.

Intended Mischaracterization

Uncertainty or mischaracterization may not always be an unintentional consequence of ambiguity. States can have incentives to exploit ambiguity deliberately in an effort to raise the risk of escalation and thus enhance prewar or intrawar deterrence. After all, the danger of a conventional war getting out of hand in ways that neither side can fully control—“the threat that leaves something to chance,” as Thomas Schelling called it—is precisely what may lead a state to think twice before contravening another’s important interests.¹¹⁰

Although Russia and the United States make threats that leave something to chance in various ways, China is most plausibly trying to do so through the exploitation of warhead ambiguity. Specifically, there has been speculation in the United States that Beijing is trying to deter Washington from launching attacks on China’s conventionally armed missiles by raising the risk that the United States might unintentionally destroy Chinese nuclear weapons in the process. Chinese experts generally dispute this claim. Indeed, China’s decision to field nuclear and conventional missiles in separate brigades supports their position (though the possibility that those missiles share a command-and-control system does not). That said, two Chinese scholars, Li Bin and Tong Zhao, who agree that Beijing did not deliberately set out to entangle its nuclear and nonnuclear forces, argue that China “is now discovering that such entanglement is potentially useful . . . and is correspondingly reluctant to . . . [embark] on a process of separation.”¹¹¹

If China does seek to deter U.S. attacks on its conventional forces through warhead ambiguity—and, to be emphatic, whether it does is unclear—then it must aim to make Washington at least uncertain about the United States’ ability to distinguish nuclear from nonnuclear delivery systems. But Chinese efforts to create such doubt could have unwelcome side effects. Specifically, in a crisis or conflict, to increase the difficulties the United States faced in characterizing Chinese missiles, China might disperse its nuclear and nonnuclear missile forces simultaneously—potentially leading nuclear missiles to be deployed earlier than they otherwise would be. Such a deployment might be motivated exclusively by a desire to protect China’s conventional missiles and not be intended to pose a direct nuclear threat to the United States. However, in that eventuality, Washington might conclude that Beijing was seriously considering nuclear use, creating a form of misinterpreted warning that could catalyze an escalation spiral (as discussed elsewhere in this chapter). The risks in this case would depend, in part, on whether China understood that the dispersal of its nuclear missiles could be misinterpreted by the United States. If it did, Beijing would be more likely to understand any U.S. response, making escalation management somewhat less demanding. If it did not, misperceptions on both sides could raise the risk of further escalation.

The use of ambiguous delivery systems for signaling would further exacerbate these challenges. Signaling operations could fail because the intended target mischaracterized the delivery systems involved as conventionally armed. Indeed, U.S. doctrine indicates that signaling operations would likely involve aircraft, which necessarily means the employment of dual-use assets (as the United States does not reserve any type of aircraft for nuclear operations).¹¹² It is less clear what types of missiles China might use for signaling purposes, and Russia's plans are murkier still. Nonetheless, if Beijing or Moscow were to consider launching nuclear attacks against regional targets, it might employ one of the ambiguous systems listed in table 2.

The signaler could take steps to mitigate the risk of ambiguous assets' being mischaracterized. For example, in theory, the United States could keep some dual-use bombers out of the conventional fight and reserve them for nuclear operations so that alerting them or flying them toward the conflict, if it came to that, would hopefully constitute a clearer signal. However, for this approach to be effective in practice, the intended recipient would have to penetrate the fog of war and obtain timely intelligence on aircraft that might be located deep within U.S. territory.¹¹³ Attacks against the intended recipient's ISR capabilities would exacerbate these difficulties.

A nuclear signal might be missed if it was sent using ambiguous delivery systems that the intended recipient wrongly concluded were conventionally armed.

Moreover, even if the option to hold aircraft in reserve exists or were created, there is no guarantee that Washington would actually exercise it: given the exigencies of conducting a large-scale conventional conflict against China or Russia, U.S. decisionmakers might choose to focus all available resources on the conventional fight and accept or ignore the increased risk of a signaling failure. Alternatively, the United States might hold aircraft in reserve, nominally for signaling purposes, but end up employing them for conventional operations as part of an intensifying air campaign or as a way to replace bombers that had been shot down, creating a particularly serious risk of a false positive.

Another way to enhance the clarity of signals would be to issue public or private statements to explain the signaler's intent. The signaler, for example, could provide details about the particular units involved and indicate that they were nuclear-armed. However, the intended recipient could interpret the statements as bluffs if, for whatever reason, it failed to detect the signaling operation itself—after all, signaling operations are needed precisely because talk, by itself, is cheap.

Moreover, historically, the statements accompanying nuclear signals have shied away from a high degree of specificity, which would be necessary to clarify warhead ambiguity.¹¹⁴ Some signals were not accompanied by statements at all. For example, in 1969, U.S. president

Richard Nixon initiated the so-called Madman Alert, a global alert of U.S. nuclear forces, to pressure the Soviet Union and North Vietnam into negotiating a tolerable settlement to the Vietnam War, but he did not issue any public or private threat to explain the signal's meaning. As a result, the Soviet Union likely failed to understand the message correctly. At the time, Moscow happened to be embroiled in a serious border dispute with Beijing and may have misinterpreted the alert as a warning against attacking China.¹¹⁵ In fact, there does not appear to be even a single example of a nuclear threat that provided specific details about an accompanying signaling operation. Even the nuclear threats Soviet premier Nikita Khrushchev made in 1958 and 1959, which were among “the clearest . . . issued in the atomic age,” did not hint at the accompanying deployment of SS-3 missiles.¹¹⁶

States' reluctance to make specific nuclear threats will likely continue. This reluctance stems partially, as in the case of the Madman Alert, from signalers' desire to avoid domestic and international opprobrium—a consideration that admittedly might not carry much weight in an actual conflict. By contrast, other motivations for vagueness would persist and might even become stronger. Militaries would likely oppose revealing information that might compromise operational effectiveness, and decisionmakers might want to avoid boxing themselves in.¹¹⁷

In short, even if states adopted measures to clarify the meaning of signaling operations, the likelihood of such signals being missed would be higher if sent with ambiguous, rather than nuclear-only, assets. Furthermore, in a real conflict, signalers would face pressures not to implement such measures fully or even at all.

If a nuclear signal were missed because of warhead ambiguity (or for any other reason), the breakdown in communications could spark inadvertent escalation.¹¹⁸ Specifically, the signaler might conclude that its message had been received but ignored, when, in fact, the intended recipient had actually missed or misinterpreted it. The signaler might respond aggressively, including, perhaps, by living up to its threat to use nuclear weapons. If the intended recipient had been willing to come to terms, rather than face a nuclear attack, the escalation would have been entirely avoidable.

False positives. If one state in a conflict detected conventional operations being conducted by its adversary, but, because of warhead ambiguity, wrongly assessed that the weapons involved were nuclear-armed, it might conclude that the opponent was issuing a nuclear signal or even surreptitiously preparing for nuclear use. Either way, the observing state would overestimate the likelihood of its adversary's using nuclear weapons—a form of misinterpreted warning.

The misinterpreted warning created by an unintentional false positive could play out in two ways (assuming it had a significant effect, which it might not). The apparent

introduction of nuclear weapons into the conflict might induce the observing state to behave in a more cautious or accommodating way to try to reduce its adversary's perceived incentives to resort to nuclear use. This effect might be termed inadvertent deterrence or inadvertent compellence, depending on the circumstances (deterrence involves threats intended to persuade an adversary not to do something; compellence involves threats intended to force an adversary to act). Alternatively, the observing state might take countermeasures to try to deter or prevent its adversary from using nuclear weapons or mitigate the consequences of such use. These steps could feed an escalation spiral or even precipitate nuclear use.¹¹⁹

Whether an unintentional false positive generated inadvertent deterrence or inadvertent escalation would likely depend on the specific circumstances of the conflict and the adversaries' capabilities, plans, and perceptions. That said, there is one overarching reason to worry about the possibility of inadvertent escalation. An unintentional false positive would result from a state's deploying nonnuclear weapons that it was not expecting to be mischaracterized. Consequently, it probably would not have considered how to conduct the deployment in a way that minimized the risks of escalation—by, for example, explaining the deployment's purpose or locating the ambiguous weapons out of range of particularly sensitive targets, such as the adversary's nuclear command-and-control assets.

In the extreme case, a misinterpreted warning could result directly in nuclear use. Specifically, if the observing state were seriously concerned that it was about to become the victim of a nuclear attack, it might use nuclear weapons first in a limited way, either to try to terrify its opponent into backing down or to destroy the weapons it thought would be used in the attack. However, the more likely consequence of a misinterpreted warning would be an escalation spiral. The observing state's response to a false positive could catalyze further escalation because it would risk appearing to its opponent as needlessly provocative, if not entirely disproportionate. The observing state, for example, might disperse vulnerable nuclear forces or make public or private nuclear threats, lending a nuclear dimension to a conflict that, as far as its opponent was concerned, had been purely conventional. The observing state could also launch nonnuclear operations designed to prevent its adversary from using the ambiguous weapons that had sparked the false positive. If such operations included attacks on dual-use command-and-control capabilities, they would risk being interpreted as preparations for nuclear use instead of an attempt to prevent the target from using nuclear weapons.¹²⁰

Historically, nuclear operations and threats have often induced reciprocal escalation, even if the resulting spirals were terminated short—often far short—of nuclear use. The catalysts of

There is one overarching reason to worry about the possibility of inadvertent escalation. An unintentional false positive would result from a state's deploying nonnuclear weapons that it was not expecting to be mischaracterized.

most of these abortive spirals were true positives. However, they are relevant to understanding the consequences of false positives because a state that had mischaracterized an opponent's weapons would not be aware of its mistake and so would respond similarly, whether the positive was true or false. When the United States alerted its nuclear forces in 1960, 1962, and 1973, the Soviet Union probably either responded in kind or made preparations to do so.¹²¹ Similarly, in October 1969, Chinese nuclear forces were placed on alert in response to Soviet nuclear threats that led Beijing to believe a nuclear attack was imminent. Meanwhile, in August 1978, the alert level of forces at some U.S. Strategic Command bases was raised after two Soviet SSBNs approached the U.S. coast.¹²²

In fact, the 1973 incident was part of an escalation spiral that was initially catalyzed by a false positive.¹²³ The U.S. alert took place on October 24, 1973, in the final days of the Yom Kippur War between Israel and a coalition of Arab states. Today, this alert is usually explained as a warning to Moscow against sending troops to Egypt.¹²⁴ While that interpretation is unquestionably correct, it is only part of the story. Secretary of defense James Schlesinger clearly indicated that the United States had a second objective when he stated, at a press conference on October 26, that the alert was triggered by “other indicators [apart from apparent preparations for troop movements] of military intelligence nature into which I shan't go.”¹²⁵

These “other indicators” were almost certainly evidence of Soviet nuclear warheads being shipped to Egypt. In 2016, historian Tim Naftali rediscovered the suspected shipment using newly declassified documents, but, in the years after the 1973 alert, it was an integral part of the narrative.¹²⁶ For example, it was highlighted in contemporary news reports, including a November 1973 article on the front page of the *New York Times*.¹²⁷ It was also discussed in early scholarly analyses of the alert—most significantly, in a 1977 article by William Quandt, a National Security Council staffer during the Yom Kippur War.¹²⁸

But compelling evidence that the warhead shipment never took place continues to be overlooked. The United States concluded that the Soviet Union was transferring nuclear warheads to Egypt after detecting radiation, apparently emanating from a Soviet freighter, the *Mezhdurechensk*.¹²⁹ Initially, at least, the CIA found this evidence to be persuasive and, on October 26, reported to Nixon that the ship was “probably” transporting nuclear warheads.¹³⁰ But the agency started to walk this conclusion back almost immediately. By October 30, it could only assess that “there is . . . at least the possibility that the Soviets have introduced nuclear weapons into the Middle East.”¹³¹ In fact, this later assessment contains no unredacted evidence that the ship was carrying warheads but does include “strong arguments against the Soviets shipping nuclear weapons to Egypt.”¹³² In the ensuing months, indications that the shipment was actually a false positive became even stronger. According to historian Jeffrey Richelson, testing showed that the radiation detector involved in the incident “was less than completely reliable” and would “often ‘detect’ such radiation when it was not present.”¹³³

One final piece of evidence against the warhead transfer is that neither the Soviet Union nor Russia ever acknowledged that it occurred. After the end of the Cold War, the United States learned numerous details about Soviet nuclear activities. For example, within months of the Soviet Union's collapse, former Soviet officials had informed their U.S. counterparts about the previously unknown shipment of nuclear-armed cruise missiles to Cuba in 1962. By contrast, in the decades since the 1973 alert, no evidence from the Soviet Union or Russia about a warhead shipment to Egypt has emerged. On the contrary, the one English-language account of the crisis that was written by a former Soviet official mentions media reports about the "transport of nuclear material" but then explicitly denies that the Politburo even discussed "the deployment . . . of weapons of mass destruction."¹³⁴

Thus, in the final analysis, it seems likely that a false positive contributed to what is sometimes seen as the most dangerous moment in the second half of the Cold War. Readings from an unreliable radiation detector were interpreted as a shipment of nuclear weapons to Egypt. This assessment contributed to a U.S. nuclear alert, which, in turn, may have led the Soviet Union to issue "a preliminary command . . . to the portion of the rocket forces that needed the most time to prepare for combat."¹³⁵ Today, a false positive created by operations involving ambiguous delivery vehicles could also catalyze an escalation spiral.

ASSESSING CAPABILITY

In any crisis or conflict, each state would collect intelligence about the other's military capabilities to help inform strategy and tactics. By degrading the quality of intelligence information, warhead ambiguity—especially if it led to a false negative—could increase the likelihood of a state's initiating potentially escalatory military operations whose dangers it had underestimated.

Unintentional attacks on an opponent's nuclear weapons are one potential danger. In a U.S.-China conflict, for example, the United States might launch attacks against China's conventionally armed ballistic missiles, which are intended to undermine U.S. power projection capabilities. If, however, the United States misidentified nuclear-armed missiles as conventionally armed ones, it might end up inadvertently targeting China's nuclear forces.¹³⁶ If limited in their extent, such strikes could not undermine China's nuclear deterrent by themselves. However, Beijing might worry that the strikes were the first wave of a wider campaign.¹³⁷ To try to coerce the United States into desisting, China might issue nuclear threats or, in the worst case, engage in limited nuclear use (its no-first-use policy notwithstanding).¹³⁸ That said, even less dramatic responses, such as mating warheads with missiles or initiating a launch-under-attack alert, could increase the risk of escalation and nuclear use later on.¹³⁹

Unintended threats to nuclear forces are not the only risk associated with conventional operations that a state might underestimate because of false negatives. Another is that one state might fail to discover that its opponent had deployed tactical nuclear weapons and, as a result, launch an operation that precipitated their use. During the Cuban Missile Crisis, for instance, the United States planned and prepared for an invasion of Cuba. In fact, had the crisis not ended when it did, it is entirely possible that those plans would have been put into action—either as a deliberate choice or because large-scale air strikes would, in McNamara’s assessment, have been “almost certain to lead to an invasion.”¹⁴⁰ Throughout the crisis, however, the United States was entirely unaware of the eighty or so nuclear-armed SSC-2A coastal defense cruise missiles that were deployed on Cuba. Soviet forces might have used these weapons against invading U.S. forces.

By degrading the quality of intelligence information, warhead ambiguity—especially if it led to a false negative—could increase the likelihood of a state’s initiating potentially escalatory military operations whose dangers it had underestimated.

One complication of assessing the effects of imperfect knowledge in this particular case is that Kennedy and the other U.S. principals were likely aware that Soviet forces had fielded very short-range, nuclear-armed Luna rockets (contrary to many recent descriptions of the crisis).¹⁴¹ They presumably anticipated the possibility of an invasion being met with a nuclear response. Moreover, if any nuclear use,

more or less inevitably, would have precipitated a general nuclear war, it would have been irrelevant whether the Soviet Union responded to an invasion with nuclear-armed cruise missiles instead of (or in addition to) the anticipated nuclear-armed rockets. But the inevitability of escalation is debatable. If Soviet nuclear use had been limited to Lunas on Cuban soil, it is feasible to imagine any nuclear exchange being entirely confined to the island. By contrast, because SSC-2A missiles could have attacked U.S. ships at sea and the U.S. naval base at Guantánamo Bay—both of which lay beyond Cuban territory—their use could have made escalation management even more difficult.¹⁴² For this reason, the United States’ lack of awareness of the nuclear-armed SSC-2A missiles may have enhanced the escalation risks.

Though probably less significant, false positives could also have escalation consequences if they led one state to underestimate an adversary’s conventional capabilities. For instance, if NATO were losing a conflict against Russia and wrongly assessed that deployed SSC-8 missiles were nuclear-armed, it might ignore them because it judged Russian nuclear use to be extremely unlikely. If those missiles were actually conventionally armed, however, and were used to hinder NATO operations significantly, pressure on the alliance to escalate the conflict could grow. Precisely how NATO might do so would depend on the circumstances, but even if nuclear threats or nuclear use did not come into play immediately, an expansion of the geographic scope or intensity of the conflict could make them more likely later on.

CONCLUSIONS AND RECOMMENDATIONS

Concerns about post-launch warhead ambiguity have tended to overshadow those associated with pre-launch ambiguity—even though the escalation risks are probably greater for the latter, once the likelihood and consequences of mischaracterization have been considered. Ideally, nuclear-armed states would reassess the cost-benefit trade-off of deploying ambiguous delivery systems to determine whether they should phase out some or all of them and revise acquisition plans. Realistically, however, states are highly unlikely to reduce their reliance on ambiguous weapons (though they may be somewhat more amenable to not increasing it).

Some of this resistance may stem from a desire to exploit warhead ambiguity to enhance deterrence. Of the three states highlighted in this report, China is the most likely to be doing so already, though the evidence is far from definitive (see box 3).¹⁴³ That said, if Russia and the United States were to systematically reassess the benefits and risks of ambiguous weapons, one or both might decide that ambiguity was actually a feature and not a bug. In principle, this conclusion would not necessarily be wrong; it would depend on whether those states had accurately estimated the benefits and risks of ambiguity.

More prosaically, the financial benefits of ambiguous, particularly dual-use, delivery systems are dramatic. If a state decides that it needs to deliver nuclear and nonnuclear warheads in a similar way over similar distances, it can choose between developing one dual-use delivery system or two single-use systems.¹⁴⁴ Opting for a dual-use system could significantly reduce research and development costs, as well as operating and maintenance costs. This economic reality makes dual-use systems extremely attractive to governments and militaries, which face fiscal pressures no matter how well-resourced.

Finally, in peacetime, when acquisition decisions are made, contingency planning occurs, and risk-reduction measures are implemented, inadvertent escalation risks—including, but not limited to, those associated with warhead ambiguity—are likely to be discounted for at least five reasons. These reasons stem from both the psychology of individual decisionmakers and the behavior of organizations, such as government bureaucracies.

First, decisionmakers may understate the chances of escalation because they are likely to base their probability estimates on “availability”—that is, “the ease with which relevant instances come to mind.”¹⁴⁵ For example, because so few people have experienced a car accident in which they were seriously injured, 90 percent of drivers believe they are better than the median driver.¹⁴⁶ Inadvertent escalation has thus far never led to nuclear weapon use so decisionmakers could be similarly inclined to ignore the danger. But because crises—and especially conflicts—that could have culminated in nuclear weapon use have been extremely rare, it is wrong to simply extrapolate from the past and conclude that nuclear escalation is exceedingly unlikely in a future crisis or conflict.¹⁴⁷

Second, even if decisionmakers do not underestimate the likelihood of inadvertent escalation, they may still dismiss it as being too unlikely to worry about, even though its consequences are potentially so enormous that the risk—the product of consequence and likelihood—should demand their attention. Research suggests that people tend to round small probabilities down to zero in decisionmaking.¹⁴⁸ Thus, they are more likely to insure against a high-probability, low-consequence event than a low-probability, high-consequence event, even when the two events have equal risk but the high-consequence event would be much more damaging. Likewise, decisionmakers may be disinclined to spend resources on reducing the risk of inadvertent escalation by, for example, buying one nuclear and one conventional delivery system, instead of a single dual-use system.

Third, the risk of nuclear escalation is effectively unquantifiable. As a result, this risk is likely to be discounted or ignored within decisionmaking processes—such as military acquisitions—that are, or at least aspire to be, driven by quantitative cost-benefit analyses. There is no credible way to assign a dollar value to all the various potential consequences of a nuclear war, which could include immediate and delayed deaths on an enormous scale, as well as deep psychological harm to the survivors.¹⁴⁹ In decisionmaking processes, costs that have not been quantified tend to get less attention. An overreliance on quantitative data has been observed in contexts as diverse as business, medicine, and the management of natural hazards, but it was first recognized—as its name, the McNamara Fallacy, may suggest—as a cause of the U.S. escalation during the Vietnam War.¹⁵⁰

Fourth, efforts to reduce nuclear risks—unilateral efforts, in particular—often lack bureaucratically or politically powerful proponents who can help ensure that they receive due consideration. The U.S. system provides a useful example. Within the U.S. Department of Defense, risk-reduction efforts frequently find supporters, even among the department’s

most senior personnel. However, such support is ad hoc and much less influential than that enjoyed by the more traditional defense functions of, say, acquisitions or contingency planning. Meanwhile, within Congress—which has a major influence on acquisitions in particular—there are rarely enough votes to block a new capability because of its escalation risks (the refusal to fund the Conventional Trident Modification was a rare exception). Risk-reduction efforts find their most natural home in the U.S. Department of State. Indeed, key State Department officials can effectively quarterback efforts to develop and, under the right political circumstances, negotiate cooperative security arrangements. However, they are much less able to effect unilateral changes to U.S. nuclear posture or planning—which become the most viable forms of risk reduction when international politics preclude cooperation.

Fifth, even though the potential dangers of nuclear escalation could become an overriding concern during a war, they are generally not apparent in peacetime and are therefore easy to ignore. Because governments have limited bandwidths, “problems whose consequences have not yet emerged are . . . at a disadvantage in the competition for elite cognitive investment.”¹⁵¹ Thus, most defense planning focuses on trying to prevent readily apparent dangers from metastasizing. The arguments for, say, improving U.S. capabilities to fight a war in the Western Pacific are regularly bolstered by Chinese military activities, such as weapon testing and exercises. By contrast, escalation dangers are essentially invisible on a day-to-day basis, and thus efforts to reduce them are likely to suffer from a lack of intellectual effort and high-level attention within overstretched bureaucracies.

Taken together, these factors greatly reduce the possibility of any state’s conducting a comprehensive reassessment of the role of ambiguous weapons in its military posture. That said, less ambitious risk-mitigation measures—both unilateral and cooperative—may be more feasible. Recommended actions for Washington to consider and adopt are presented below. This framing does not imply, however, that risk mitigation is solely Washington’s responsibility; rather, this charge should be shared with all nuclear-armed states that possess ambiguous weapons, particularly China and Russia. To this end, Beijing and Moscow should engage constructively with any good-faith proposals for cooperation that Washington may offer and develop their own unilateral risk-reduction measures in parallel. Chinese and Russian scholars will hopefully respond to this report by making their own proposals, tailored to their states’ political, military, and bureaucratic structures.

EXERCISE RESTRAINT IN ACQUISITIONS

While existing categories of ambiguous weapons are here to stay, the United States may be somewhat more amenable to exercising restraint in introducing new ones. To this end, procedures should be established to ensure that escalation risks are factored into relevant

acquisition decisions. Even if such risks end up being underweighted, as seems likely, giving them some attention should still promote better policy outcomes. **The U.S. secretary of defense should, therefore, require relevant Department of Defense decisionmakers to consider any potential escalation risks resulting from warhead ambiguity when deciding whether to acquire new categories of ambiguous weapons. To this end, those decisionmakers should be presented with a formal assessment of such risks.**¹⁵² Meanwhile, China, Russia, and other nuclear-armed states can and should create their own parallel requirements.

The United States should propose to China and Russia that they jointly agree not to acquire ambiguous intercontinental ballistic, cruise, or hypersonic boost-glide missiles.

Risk assessments should not be prepared by acquisition personnel (who generally lack the relevant expertise), but by a civilian-led team reporting to the under secretary of defense for policy. This team should draw on broad-based strategic and country-specific expertise, including from nondefense intelligence agencies. The first such assessment should be conducted for

the planned nuclear-armed sea-launched cruise missile. Even though this weapon may not be dual-use itself, it will almost certainly be deployed on platforms—such as attack submarines or surface ships—that currently carry only conventional weapons.

Ambiguous intercontinental missiles, whether ballistic, cruise, or hypersonic boost-glide, are especially significant because the escalation risks associated with ambiguous weapons probably increase as their ranges do. Fortunately, no nuclear-armed state appears to have acquired such a weapon yet, largely because of the technical challenges to ensuring sufficient accuracy for a nonnuclear warhead to be effective. This barrier, however, is unlikely to hold for much longer. For this reason, **the United States should propose to China and Russia that they jointly agree not to acquire ambiguous intercontinental ballistic, cruise, or hypersonic boost-glide missiles.** In theory, the same outcome could be achieved through a series of parallel unilateral policy decisions, but a cooperative approach would allow for discussions about definitions and implementation, and potentially even verification.

If a joint prohibition were agreed upon, China, Russia, and the United States would surely choose to keep all their ICBMs and SLBMs nuclear-armed. Only Russia has shown an interest in developing an intercontinental cruise missile, the nuclear-powered Burevestnik, on which there would be little point deploying a nonnuclear warhead. However, while Russia would likely choose to arm intercontinental boost-glide missiles with nuclear warheads, and China might do so, too, the United States would likely deploy such missiles for nonnuclear strikes.

This asymmetry might be mutually acceptable because of differing perceptions about the effectiveness of U.S. missile defenses. Russia's development of boost-glide weapons has

largely been driven by the possibility that U.S. missile defenses could undermine its ICBM and SLBM forces over time.¹⁵³ Indeed, Russia's intercontinental glider, Avangard, which Moscow claims has already been deployed, is probably exclusively nuclear-armed. Russia, therefore, might agree to forsake conventionally armed intercontinental gliders if the agreement also limited U.S. capabilities and mitigated the risk of nuclear war. And Beijing might follow suit, as it shares Moscow's concerns about U.S. missile defenses. However, because China is less able than Russia to target the United States with conventional weapons, its incentives to place nonnuclear warheads on intercontinental gliders could be stronger. U.S. decisionmakers, by contrast, tacitly recognize that the United States is already vulnerable to a nuclear attack by China or Russia and that, as a matter of fact (if not of choice), the pursuit of invulnerability would be infeasible.¹⁵⁴ Thus, they should be open to an agreement that limited the development of Chinese and Russian conventional capabilities, even if it left advances in their nuclear capabilities unchecked.

All that said, China and Russia are probably significantly more interested than Washington in eventually fielding ambiguous intercontinental missiles, particularly hypersonic boost-glide weapons.¹⁵⁵ Therefore, they might view a U.S. proposal to refrain from acquiring such missiles as an attempt to secure a unilateral advantage for the United States. One way to address this problem would be to include the prohibition in a package with another measure of more interest to China and Russia. Beijing and Moscow could usefully consider what this measure might be.

BE TRANSPARENT ABOUT CAPABILITIES

Nuclear-armed states that have acquired ambiguous weapons to reduce costs—rather than to enhance deterrence—may be amenable to implementing transparency measures that could modestly mitigate warhead ambiguity. Incorrect or uncertain design assessments are one potential cause of incorrect or uncertain characterization. Currently, China and Russia are only sometimes transparent about what type or types of warheads their weapon systems are designed to carry. The United States is generally more transparent. But the information Washington provides is usually intended to meet domestic needs (such as budget justifications for Congress), and Moscow's and Beijing's level of confidence in it is unclear. For example, Russian officials and experts have expressed concerns that future U.S. boost-glide weapons will be dual-use in spite of U.S. assertions that they will be exclusively nonnuclear.¹⁵⁶ To address this problem, **the United States should propose to China and Russia that they declare, publicly or privately, each type of missile and aircraft they deploy as nuclear-armed, conventionally armed, or dual-use.** Each participant should provide updates when weapons are modified and new types are acquired. Declarations would be most effective if accompanied by intergovernmental discussions to build confidence in their veracity. But, even alone, they should still have value.

More ambitiously, **the United States should propose to China and Russia that they privately discuss any observable differences in design or deployment patterns between their nuclear- and conventionally armed ambiguous weapons.** Even weapons that are physically identical may be deployed or operated in somewhat different ways. For example, Beijing and Moscow could indicate to Washington whether their nuclear-armed mobile missiles are typically accompanied by different support vehicles than their nonnuclear missiles. Meanwhile Washington could explain whether, say, its nuclear- and conventionally armed aircraft typically have different operational profiles. This proposal would be more feasible if China and Russia were more confident in the survivability of their nuclear forces. Even if they did not acquire ambiguous weapons to enhance force survivability, they may worry that highlighting how their nuclear and nonnuclear delivery systems could be distinguished would make it easier for the United States to target the former. Therefore, discussions on observable differences may need to occur in the context of arms control designed to reduce perceived threats to nuclear forces.

IMPROVE OPERATIONAL PLANNING

The most promising area for risk reduction is probably military planning and crisis and conflict management. Most fundamentally, **the U.S. Department of Defense and relevant combatant commands should plan for crises and conflicts on the assumption that each participant might mischaracterize or be unable to characterize the other's ambiguous weapons.** Starting from this premise, to reduce the risks of inadvertent escalation, defense planners should consider how to adjust the United States' contingency plans and its approach to managing crises and conflicts. Identifying potential adjustments will require extensive analysis, particularly from personnel with access to relevant classified information. In undertaking this task, planners should consider the following four general principles.

First, and most importantly, **the U.S. secretary of defense should require relevant decisionmakers to consider any potential escalation risks resulting from warhead ambiguity when deciding whether to authorize strikes with or against ambiguous delivery systems. To this end, those decisionmakers should be presented with a formal assessment of such risks.** A team that includes civilian strategists and intelligence personnel with expertise on the adversary should prepare the assessment (which mirrors those already conducted to evaluate the legality of various kinds of operations). Critically, if the potential operation involves attacks against ambiguous assets, the intelligence analysts responsible for assessing how those weapons are armed should include a clear statement indicating their level of confidence in their findings.

Second, **U.S. military planners and decisionmakers should be aware of the trade-offs associated with the use of ambiguous delivery systems for signaling operations.** Ideally,

the United States would refrain entirely from signaling with ambiguous assets. But its actual nuclear force structure makes a blanket recommendation imprudent. Dual-use aircraft are almost certainly the United States' preferred delivery system for signaling operations. SSBNs, which are reserved for nuclear operations, are the most plausible alternative.¹⁵⁷ Using them for signaling would reduce the risk of misinterpretation because of warhead ambiguity.¹⁵⁸ However, the survivability of the SSBNs might be compromised. Moreover, China and Russia might worry about submarines' being positioned close to their coasts to launch attacks on their nuclear forces with little warning. For this reason, a signal sent with SSBNs would still carry escalation risks, albeit different ones from a signal sent with dual-use aircraft. In practice, therefore, it is not possible to provide U.S. officials with stronger advice than to be aware of and weigh the risks associated with each signaling option.¹⁵⁹

Third, **if the United States uses ambiguous delivery systems for nuclear signaling, it should take steps to mitigate the risks associated with warhead ambiguity.** For example, it could hold some ambiguous aircraft back from a conventional war and reserve them exclusively for nuclear operations, should such operations become necessary. Alternatively or additionally, it could accompany signaling operations involving ambiguous weapons with verbal threats that referenced the units involved and explicitly indicated that they were nuclear-armed. This approach could be described as messaging and might reduce the need for tacit understanding between the United States and its adversaries about how to interpret signals. Neither of these options would be foolproof, but each should help reduce the risk of inadvertent escalation.

Fourth, **the United States should offer verbal assurances to reduce the likelihood of false positives resulting from operations involving conventionally armed ambiguous weapons.** In a crisis or conflict, just as Washington might issue threats to clarify the meaning of nuclear signals, it could offer appropriate assurances that ambiguous weapons were conventionally armed. Given the need for operational secrecy, the U.S. military might be reluctant to describe the weapons involved in an ongoing operation. But even very general statements could prove useful. For example, if no U.S. aircraft were loaded with nuclear weapons, the United States could say so and periodically repeat its assurance, unless and until such loading began.

* * *

It would be understandable if busy military and defense officials balked at this long, complex to-do list. What should motivate them is the likelihood that they will have to manage the effects of warhead ambiguity if a conflict or crisis occurs. In past crises, and even in peacetime, ambiguous weapons have frequently been mischaracterized or uncertainly characterized. Now, given militaries' increasing reliance on ambiguous weapons, the difficulty of characterizing an adversary's weapons, particularly in the fog of war, is growing.

Even among the officials who agree that the danger is real, one view may be that no immediate action is required because it would be possible, in a crisis or conflict, to manage the risks on the fly. By the time one state had mischaracterized its adversary's weapons, however, the prospects for managing any resultant escalation would have diminished. After all, the adversary would likely not even know about the mistake, precluding the possibility of its trying to correct the misapprehension. The right time to start thinking about how to mitigate the risks of pre-launch warhead ambiguity is, therefore, long before the onset of a crisis or conflict—it is today.

APPENDIX: FRANCE, INDIA, PAKISTAN, AND NORTH KOREA

China, Russia, and the United States are not the only states that deploy ambiguous delivery systems. Five out of the other six nuclear-armed states also have them (the only exception is the United Kingdom, which deploys nuclear weapons exclusively aboard submarines that do not carry nonnuclear weapons, except for self-defense). However, while Israel almost certainly fields dual-use capabilities—F-16 aircraft, most notably—none of its plausible adversaries are currently nuclear-armed, significantly mitigating the nuclear escalation risks of any conflict involving Israel.¹⁶⁰ As a result, this appendix focuses on France, India, Pakistan, and North Korea.

France fields two types of dual-use aircraft: land-based Rafale BF3 and carrier-based Rafale MF3 fighters-bombers.¹⁶¹ Both can carry nuclear-armed supersonic cruise missiles and are used for conventional operations; indeed, French experts stress that such versatility is a major advantage.¹⁶² France's one aircraft carrier, the *Charles de Gaulle*, does not carry nuclear weapons on a day-to-day basis but could be loaded with them in a crisis or conflict, making it NATO's only potentially ambiguous surface ship.

The ambiguity associated with French forces stems exclusively from the challenge of determining whether individual delivery systems or platforms have been armed with nuclear or nonnuclear weapons. In the cases of India, Pakistan, and North Korea, this challenge is compounded by the additional difficulty of determining what warhead types are available for various types of missiles.

India and Pakistan have deployed a wide variety of delivery systems for nuclear operations, many of which are known or suspected, especially by one another, to be dual-use. All of India's and Pakistan's aircraft that are used to carry nuclear weapons are also available for conventional operations. However, there is a question about whether some Indian aircraft—notably legacy MiG-27s and Rafale fighter-bombers being acquired from France—are, or will be, conventional-only or dual-use.¹⁶³

India and Pakistan also field a variety of ground-launched missiles, many of which have been described by official sources as, or are otherwise suspected to be, dual-use.¹⁶⁴ In 2003, when India tested its short-range Prithvi missile, anonymous officials described it as such.¹⁶⁵ India's Agni-2 IRBM and its other land-based ballistic missiles with shorter ranges are probably also dual-use, though official confirmation is not available.¹⁶⁶ One Indian official has also hinted that the short-range Prahaar battlefield missile, which is under development and is expected to replace the Prithvi, will be dual-use.¹⁶⁷ Moreover, and perhaps more importantly, there is a widespread belief within the Pakistani strategic community that this is probably the case.¹⁶⁸ There is more uncertainty about the Agni-3 IRBM, but it is probably nuclear-only because of accuracy limitations (even if there would be no technical barrier to loading it with a nonnuclear warhead). Similarly, the longer-range ballistic missiles that India is planning to deploy will also likely be nuclear-only.

Official Pakistani sources, meanwhile, have stated or implied that at least four of the country's land-based ballistic missiles can carry nuclear or conventional warheads: the short-range Abdali (Hatf-2) and Ghaznavi (Hatf-3) and the medium-range Shaheen-1 (Hatf-4) and Shaheen-3 (Hatf-6).¹⁶⁹ That said, one former officer with Pakistan's Strategic Plan Division suggests that Pakistan may be deliberately cultivating ambiguity and that the Abdali is actually conventional-only.¹⁷⁰ In any case, since the Shaheen-3, which has yet to be fielded, is Pakistan's longest-range ballistic missile, it is possible that other Pakistani missiles are also dual-use. The Nasr (Hatf-9), with a reported range of only 60–70 kilometers (38–44 miles), is the most likely candidate.¹⁷¹

According to the U.S. National Air and Space Intelligence Center (NASIC), Pakistan's Babur (Hatf-7) ground-launched cruise missile is dual-use.¹⁷² Conversely, India's BrahMos cruise missile, which can be deployed on a ground-based launcher among other options, has not officially been assigned a nuclear role, and NASIC assesses it to be conventional-only, in spite of speculation that it is “nuclear-capable.”¹⁷³

Pakistani diesel-electric submarines will become ambiguous when they are used to carry a sea-launched cruise missile, Babur-3, which official sources have implied is dual-use.¹⁷⁴ Meanwhile, there may already be a degree of ambiguity around the two Indian Sukanya-class patrol vessels on which Dhanush ship-launched ballistic missiles are deployed.¹⁷⁵ This missile is based on the dual-use Prithvi-2, and there has been speculation that it has a nuclear role.

One factor that may mitigate the escalation risks associated with pre-launch warhead ambiguity in South Asia is ISR limitations. After all, if one state failed to detect another's weapons, it could not mischaracterize them. Pakistan, in particular, could face significant challenges in detecting Indian ground-launched missiles after dispersal.¹⁷⁶ India, by contrast, has deployed a fairly sophisticated suite of ISR assets that could probably detect at least some Pakistani missiles prior to launch (though its partial reliance on drones represents a significant weakness).¹⁷⁷ However, both states have well-developed air-defense systems that have a proven ability to detect each other's aircraft.

North Korea has deployed a variety of ambiguous land-based ballistic missiles and is developing more. Because of U.S. defense commitments and the deployment of U.S. forces to Japan and South Korea, ambiguous North Korean missiles that lack the range to reach the United States could still exacerbate escalation risks in a U.S.–North Korean crisis or conflict.

Even the U.S. intelligence community may face challenges in assessing which North Korean missiles are dual-use. That said, some are more likely candidates than others. North Korea's longest-range land-based missiles—in particular, the HS-12 IRBM and the HS-14 and HS-15 ICBMs—are probably exclusively nuclear-armed. Even though there would be no technical barrier to loading them with conventional (or even chemical) warheads presumed accuracy limitations make such a choice unlikely.¹⁷⁸ Conversely, North Korea may not have developed small enough nuclear warheads to be loaded onto the very short-range KN-02 or KN-09 missiles.¹⁷⁹ However, some, or perhaps even all, of its other missiles—those with ranges of between roughly 300 and 1,500 kilometers (190 and 940 miles)—may be dual-use.

Beyond these technological considerations, the organization of North Korea's missile forces may provide some hints about how missiles are armed. Missiles assigned to the Korean People's Army (KPA) Artillery Bureau may be exclusively nonnuclear (these include the various ground-launched ballistic missile types first tested in 2019). Missiles assigned to the KPA Strategic Force, which include at least some Scuds and Nodongs, may be nuclear or dual-use.¹⁸⁰ Recent references to nuclear-armed "Hwasong artillery" units within the Strategic Force may suggest that nuclear-armed and conventionally armed dual-use missiles have become organizationally distinct.¹⁸¹ That said, there is significant uncertainty about the organization of North Korea's ballistic missile forces and how this organization, which is apparently in flux, will change further in response to future technological and doctrinal developments.

NOTES

- 1 Gregg Herken, *The Winning Weapon: The Atomic Bomb in the Cold War, 1945–1950* (New York: Alfred A. Knopf, 1980), 259.
- 2 “60 B-29’s Ordered to Fly to Britain,” *New York Times*, July 16, 1948, 4.
- 3 David G. Coleman, “The Missiles of November, December, January, February... The Problem of Acceptable Risk in the Cuban Missile Crisis Settlement,” *Journal of Cold War Studies* 9, no. 3 (Summer 2007): 18–19.
- 4 Dana W. White, “U.S. Flies B1-B Bomber Mission off of North Korean Coast,” Press Release, U.S. Department of Defense, September 23, 2017, <https://dod.defense.gov/News/News-Releases/News-Release-View/Article/1322213/US-flies-b1-b-bomber-mission-off-of-north-korean-coast/>.
- 5 Korean Central News Agency (KCNA), “U.S. Imperialists’ Reckless Military Provocation Under Fire,” May 30, 2017, <https://kcnawatch.org/newstream/1496122257-505361019/u-s-imperialists-reckless-military-provocation-under-fire/>; KCNA, “U.S. Reckless Nuclear War Frenzy Slammed,” August 9, 2017, <https://kcnawatch.org/newstream/1502235077-209067100/u-s-reckless-nuclear-war-frenzy-slammed/>; and KCNA, “U.S. Surprise Nuclear Strike Drill in S. Korea,” November 3, 2017, <https://kcnawatch.org/newstream/1509661871-713076542/u-s-surprise-nuclear-strike-drill-in-s-korea/>.
- 6 See, for example, Matthew Costlow, “The New Nuclear Cruise Missile and the Stability Argument,” *RealClear Defense*, February 8, 2016, https://www.realcleardefense.com/articles/2016/02/09/the_new_nuclear_cruise_missile_and_the_stability_argument_109003.html; and William J. Perry and Andy Weber, “Mr. President, Kill the New Cruise Missile,” *Washington Post*, October 15, 2015, https://www.washingtonpost.com/opinions/mr-president-kill-the-new-cruise-missile/2015/10/15/e3e2807c-6ecd-11e5-9bfe-e59f5e244f92_story.html?utm_term=.f396b1a16661. Concerns about ambiguity emerged before plans to develop a conventional variant of this missile (which has an uncertain future).
- 7 What is probably the most relevant example of post-launch ambiguity involving a nonnuclear system that was misidentified as nuclear-armed occurred in 1995 when Russia briefly concluded that a Norwegian sounding rocket was a nuclear-armed Trident D-5 sea-launched ballistic missile. However, given this incident’s occurrence in peacetime, the lack of direct and detailed evidence about how Russia’s military and civilian leaders perceived the incident, and subsequent improvements to the Russian early-warning system, there has been an unsurprising lack of consensus about its significance. Theodore A. Postol, “An Evaluation of the Capabilities and Limitations of Non-Nuclear-Armed Trident Ballistic Missiles for Short-Time Conventional Strikes,” presentation, Washington, DC, October 5-6, 2006, 10; and Keith Payne, Thomas Scheber, Mark Schneider, David Trachtenberg, and Kurt Guthe, *Conventional Prompt Global Strike: A Fresh Perspective* (Fairfax, VA: National Institute Press, June 2012), 48, http://www.nipp.org/wp-content/uploads/2015/11/CPGS_REPORT-for-web.pdf.

- 8 U.S. Department of Defense, *Summary of the 2018 National Defense Strategy of the United States of America: Sharpening the American Military's Competitive Edge*, [2018], 4, <https://dod.defense.gov/Portals/1/Documents/pubs/2018-National-Defense-Strategy-Summary.pdf>.
- 9 Joe Gould and Aaron Mehta, "US to Europe: Fix Open Skies Treaty or We Quit," *Defense News*, November 21, 2019, <https://www.defensenews.com/pentagon/2019/11/21/us-to-europe-fix-open-skies-treaty-or-we-quit/>.
- 10 Launch could occur after separation in the case of a cruise missile with loitering capability.
- 11 Here, the term "dual-use" is used instead of "dual-capable" because many weapons systems could carry either nuclear or nonnuclear warheads, but only a subset are actually assigned both nuclear and nonnuclear missions.
- 12 For more on entanglement, see 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 (Summer 2018): 56-99; and James M. Acton, ed., *Entanglement: Russian and Chinese Perspectives on Non-Nuclear Weapons and Nuclear Risks* (Washington, DC: Carnegie Endowment for International Peace, 2017), https://carnegiendowment.org/files/Entanglement_interior_FNL.pdf.
- 13 Official U.S. sources have occasionally stated or implied that the B1-B bomber is still dual-use, but such instances are almost certainly mistakes and not part of a deliberate policy of ambiguity. For an example, see Jeffrey Lewis, Twitter post, December 20, 2018, 5:29pm, <https://twitter.com/ArmsControlWonk/status/1075880836807897088>.
- 14 Feroz Hassan Khan, *Eating Grass: The Making of the Pakistani Bomb* (Stanford, CA: Stanford University Press, 2012), 237-238.
- 15 For classic overviews, see Robert Jervis, *Perception and Misperception in International Politics*, new edition (Princeton, NJ: Princeton University Press, 2017); and Daniel Kahneman, *Thinking Fast and Slow* (New York: Farrar, Straus and Giroux, 2011).
- 16 See, for example, Costlow, "The New Nuclear Cruise Missile and the Stability Argument"; Perry and Weber, "Mr. President, Kill the New Cruise Missile"; James M. Acton, *Silver Bullet? Asking the Right Questions About Conventional Prompt Global Strike* (Washington, DC: Carnegie Endowment for International Peace, 2013), 113-118, <https://carnegiendowment.org/files/cpgs.pdf>; Payne et al., *Conventional Prompt Global Strike*, 38-48; M. Elaine Bunn and Vincent A. Manzo, *Conventional Prompt Global Strike: Strategic Asset or Unusable Liability?* Strategic Forum 263 (Institute for National Security Studies, National Defense University, February 2011), 14-17, <http://ndupress.ndu.edu/Portals/68/Documents/stratforum/SF-263.pdf>; Bruce M. Sugden, "Speed Kills: Analyzing the Deployment of Conventional Ballistic Missiles," *International Security* 34, no. 1 (Summer 2009): 141-144; Joshua Pollack, "Evaluating Conventional Prompt Global Strike," *Bulletin of the Atomic Scientists* 65, no. 1 (January/February 2009): 18-19; Committee on Conventional Prompt Global Strike Capability, Naval Studies Board, and Division on Engineering and Physical Sciences, National Research Council of the National Academies, *U.S. Conventional Prompt Global Strike: Issues for 2008 and Beyond* (Washington, DC: National Academies Press, 2008), 71-77, <https://www.nap.edu/catalog/12061/us-conventional-prompt-global-strike-issues-for-2008-and-beyond>; Postol, "An Evaluation of the Capabilities and Limitations of Non-Nuclear-Armed Trident Ballistic Missiles for Short-Time Conventional Strikes," 10-11 and 14-43; and Pavel Podvig, *Russia and the Prompt Global Strike Plan*, PONARS Policy Memo 417 (December 2006), 2, http://www.ponarseurasia.org/sites/default/files/policy-memos-pdf/pm_0417.pdf.
- 17 Caitlin Talmadge, "Would China Go Nuclear? Assessing the Risk of Chinese Nuclear Escalation in a Conventional War With the United States," *International Security* 41, no. 4

- (Spring 2017): 73–75 and 84–90; and Wu Riqiang, *Sino-U.S. Inadvertent Escalation* (Program on Strategic Stability Evaluation, Georgia Institute of Technology), 5–6 and 7–8, <https://www.yumpu.com/en/document/view/38495325/wu-sino-us-inadvertent-escalation-program-on-strategic-stability>.
- 18 The state could also try to intercept the attack, but the authority to do so would most likely be predelegated to lower-level commanders directly responsible for air- and missile-defense operations.
 - 19 Indeed, whatever Japanese air-defense forces were present around Hiroshima on August 6, 1945, presumably failed to realize that the *Enola Gay* was carrying a nuclear warhead. This ambiguity was not just the result of Japan’s lack of awareness of the atomic bomb’s existence. Prior to the attack, small unescorted groups of B-29 bombers flew high-altitude practice runs over Japan, partly to “accustom” it to such operations (for many months previously, conventional bombing raids had been undertaken at low altitude by large escorted groups). Richard Rhodes, *The Making of the Atomic Bomb* (New York: Simon & Schuster, 1986), 687.
 - 20 Gregory Kulacki, *The Chinese Military Updates China’s Nuclear Strategy* (Cambridge, MA: Union of Concerned Scientists, March 2015), 4, <http://www.ucsusa.org/sites/default/files/attach/2015/03/chinese-nuclear-strategy-full-report.pdf>.
 - 21 In fact, ambiguity could likely only precipitate escalation in a conflict involving both states.
 - 22 Mischaracterization may be more likely to result from ISR assets with less ability to detect subtle differences between nuclear- and conventionally armed delivery systems.
 - 23 Prior to the Presidential Nuclear Initiatives of 1991 and 1992, U.S. ships and submarines carried both nuclear and conventional weapons, whereas PLA Navy forces have never done so. Arms Control Association, “The Presidential Nuclear Initiatives (PNIs) on Tactical Nuclear Weapons at a Glance,” July 2017, <https://www.armscontrol.org/factsheets/pniglance>.
 - 24 Igor Sutyagin, *Atomic Accounting: A New Estimate of Russia’s Non-Strategic Nuclear Forces*, Occasional Paper (London: Royal United Services Institute, November 2012), 39–51, https://rusi.org/sites/default/files/201211_op_atomic_accounting.pdf. This posture appears to contravene Russian commitments made under the Presidential Nuclear Initiatives.
 - 25 Defense Intelligence Agency, *Russia Military Power: Building a Military to Support Great Power Aspirations*, DIA-11-1704-161 (Defense Intelligence Agency, 2017), 68, <https://www.dia.mil/Portals/27/Documents/News/Military%20Power%20Publications/Russia%20Military%20Power%20Report%202017.pdf>.
 - 26 In theory, an aircraft that was assigned exclusively to nonnuclear operations could be converted to carry nuclear munitions (or vice versa). However, a meaningful distinction can be drawn between this kind of inherent capability and actually realizing it through integrating a nonnuclear bomber into nuclear training and operational plans.
 - 27 Robert Farley, “The B-58 Hustler: America’s Cold War Nuclear Bomber Blunder,” *The National Interest*, June 10, 2016, <https://nationalinterest.org/feature/the-b-58-hustler-americas-cold-war-nuclear-bomber-blunder-16547>.
 - 28 It does appear, however, that certain variants were used exclusively for nuclear operations during certain time periods. Pavel Podvig assesses that Russian bombers capable of carrying nuclear gravity bombs have always been dual-use. However, because all early Russian air-launched cruise missiles were nuclear-armed (with the possible exception of a conventional antiradar variant of the Kh-22 missile), he believes that Russia’s cruise missile-carrying bombers were originally involved exclusively in nuclear operations. Of Russia’s current bomber force, the Tu-160 and Tu-95MS bombers were probably the last to acquire a nonnuclear role. Pavel Podvig, e-mail communication, April 2016. See also Pavel Podvig, ed., *Russian Strategic Nuclear Forces* (Cambridge, MA: MIT Press, 2004), ch. 6.

- 29 Vladimir Putin, “Presidential Address to the Federal Assembly,” Moscow, March 1, 2018, <http://en.kremlin.ru/events/president/news/56957>.
- 30 Hans M. Kristensen, Robert S. Norris, and Matthew G. McKinzie, *Chinese Nuclear Forces and U.S. Nuclear War Planning* (Washington, DC: Federation of American Scientists & Natural Resources Defense Council, November 2006), 93–95, <https://fas.org/nuke/guide/china/Book2006.pdf>.
- 31 Office of the Secretary of Defense, *Military and Security Developments Involving the People’s Republic of China 2019*, annual report to Congress (Washington, DC: U.S. Department of Defense, 2019), 41, https://media.defense.gov/2019/May/02/2002127082/-1/-1/2019_CHINA_MILITARY_POWER_REPORT.pdf.
- 32 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/>; Hans M. Kristensen and Robert S. Norris, “Chinese Nuclear Forces, 2018,” *Bulletin of the Atomic Scientists* 74, no. 4 (2018): 289–295; Office of the Secretary of Defense, *Military and Security Developments Involving the People’s Republic of China 2019*; Hans M. Kristensen and Matt Korda, “Russian Nuclear Forces, 2019,” *Bulletin of the Atomic Scientists* 75, no. 2 (2019): 73–84; Defense Intelligence Ballistic Missile Analysis Committee, *Ballistic and Cruise Missile Threat 2017*, NASIC-1031-0985-17 (Wright-Patterson Air Force Base, Ohio: National Air and Space Intelligence Center, June 2017), 37; Sutyagin, *Atomic Accounting*, 85; and Hans M. Kristensen and Robert S. Norris, “United States Nuclear Forces, 2018,” *Bulletin of the Atomic Scientists* 74, no. 2 (2018): 120–131.
- 33 Director of Central Intelligence, *Soviet Technical Capabilities in Guided Missiles and Space Vehicles*, National Intelligence Estimate 11-5-61, April 25, 1961, Table IV, https://www.cia.gov/library/readingroom/docs/DOC_0000278407.pdf.
- 34 Author calculation.
- 35 The 1961 National Intelligence Estimate did not rule out the possibility of longer-range Soviet missiles being used for chemical weapons delivery “for certain limited purposes.” National Intelligence Estimate 11-5-61, 20.
- 36 *Soviet Military Power 1985* (Washington, DC: U.S. Government Printing Office, April 1985), 38, states that deployments of the SS-12 Mod 2 to Eastern Europe began in 1984 but may imply that deployments within the Soviet Union began earlier. Separately, there is some uncertainty about whether the original SS-12 was dual-use. *Soviet Military Power* (Washington, DC: U.S. Government Printing Office, [1981]), 31, states unambiguously that it was. Later editions are more equivocal. See, for example, *Soviet Military Power 1985*, 38. Moreover, unredacted portions of a 1965 Central Intelligence Agency (CIA) memo about the SS-12’s deployment do not mention the possibility of its being conventionally armed. CIA, Office of Current Intelligence, “The SS-12,” Intelligence Memorandum, December 30, 1965, 1, RDP79T00472A000600060002, CREST System, <https://www.cia.gov/library/readingroom/docs/CIA-RDP79T00472A000600060002-8.pdf>.
- 37 U.S. Senate Armed Services Committee, *Fiscal Year 1978 Authorization for Military Procurement, Research and Development, and Active Duty, Selected Reserve, and Civilian Personnel Strengths*, Part 8, *Research and Development*, 95th Cong., 1st sess., March 2, 1977, 5313 and 5362, <https://books.google.com/books?id=-c8QAAAAIAAJ>.
- 38 Separately, in 1993, the CIA assessed that China had developed a nuclear warhead for the DF-15 missile, but it is likely that this missile has been deployed only in its conventional configuration. Kristensen and Norris, “Chinese Nuclear Forces, 2018,” 292; and Jeffrey

- Lewis, *Paper Tigers: China's Nuclear Posture*, Adelphi 446 (Abingdon, U.K.: Routledge for the International Institute for Strategic Studies, 2014), 100.
- 39 Andrew S. Erickson, "Academy of Military Science Researchers: 'Why We Had to Develop the Dongfeng-26 Ballistic Missile'—Bilingual Text, Analysis, and Related Links," *andrewerickson.com* (blog), December 5, 2015, <http://www.andrewerickson.com/2015/12/academy-of-military-science-researchers-why-we-had-to-develop-the-dongfeng-26-ballistic-missile-bilingual-text-analysis-links/>; and Office of the Secretary of Defense, *Military and Security Developments Involving the People's Republic of China 2019*, 44. Two variants of this missile, with slightly different canisters, have been observed. Both variants appear to be dual-use. Personal communication, Scott LaFoy, April 2019.
- 40 Panda, "Introducing the DF-17."
- 41 Office of the Secretary of Defense, *Military and Security Developments Involving the People's Republic of China 2019*, 44, 62, and 66. See also Lewis, *Paper Tigers*, 107–108 and 111.
- 42 Personal communication, Scott LaFoy, April 2019.
- 43 Personal communication, Scott LaFoy, April 2019. The CSS-5 Mod 6 is first mentioned in the 2016 edition of *Military and Security Developments Involving the People's Republic of China*. See Office of the Secretary of Defense, *Military and Security Developments Involving the People's Republic of China 2016*, annual report to Congress (Washington, DC: U.S. Department of Defense, 2016), 58.
- 44 Daniel Coats, statement on "Russia's Intermediate-Range Nuclear Forces (INF) Treaty Violation," November 30, 2018, <https://www.dni.gov/index.php/newsroom/speeches-interviews/item/1923-director-of-national-intelligence-daniel-coats-on-russia-s-inf-treaty-violation>. The U.S. intelligence community reportedly estimates its range to be 2,000 km with a conventional warhead or 2,350 km with a nuclear warhead. Ankit Panda, "U.S. Intelligence: Russia Tried to Con the World With Bogus Missile," *Daily Beast*, February 18, 2019, <https://www.thedailybeast.com/us-intelligence-russia-tried-to-con-the-world-with-bogus-missile>.
- 45 Kremlin, transcript of "Meeting With Sergei Lavrov and Sergei Shoigu," Moscow, February 2, 2019, <http://en.kremlin.ru/events/president/news/59763>. If the hypersonic missile is based on boost-glide technology, it would probably not have been prohibited by the INF Treaty, even if its range is between 500 km and 5,500 km. Payne et al, *Conventional Prompt Global Strike*, 30–32.
- 46 Matthew Bodner, "Russia Bids Farewell to INF Treaty With Fresh Nuclear Development Plans," *Defense News*, February 6, 2019, <https://www.defensenews.com/smr/nuclear-arsenal/2019/02/06/russia-bids-farewell-to-inf-treaty-with-fresh-nuclear-development-plans/>.
- 47 If the weapons were based in silos or on naval platforms, then any ambiguity would technically be associated with the silo or vessel rather than the missile.
- 48 There have been a few reports that Avangard, a Russian intercontinental boost-glide missile is dual-use. However, these reports are likely incorrect given the technical challenges of ensuring accuracy over such long distances and Putin's failure to describe Avangard as dual-use, when he unveiled it on March 1, 2018, in contrast to his description of Kinzhal. Putin, "Presidential Address to the Federal Assembly."
- 49 For an overview of this and similar programs, see Acton, *Silver Bullet?*, 10–11 and 37–44.
- 50 Office of the Secretary of Defense, *Military and Security Developments Involving the People's Republic of China 2019*, 61 and 67.
- 51 Defense Intelligence Ballistic Missile Analysis Committee, *Ballistic and Cruise Missile Threat 2017*, 37. In this document, the SSC-5 is listed by its Russian designation, 3M55.

- 52 Kristensen and Norris, “Chinese Nuclear Forces, 2018,” 294. Moreover, no recent edition of the U.S. Department of Defense publication, *Military and Security Developments Involving the People’s Republic of China*, has suggested that any of these missiles are nuclear-armed.
- 53 Jeffrey T. Richelson, “Spying on the MiGs,” *Air Force Magazine* (February 28, 2011), <https://www.airforcemag.com/article/0311MiGs/>.
- 54 U.S. Interests Section Havana to Department of State, “MiG-23’s in Cuba,” Telegram 1052, February 20, 1979, 1979HAVANA1052, RDP06T01849R000100040019, CREST System, 1, <https://www.cia.gov/library/readingroom/docs/CIA-RDP06T01849R000100040019-1.pdf>. Confusingly, sources differ on the correct “translations” between U.S. and Soviet designation; this report uses the designations from the contemporary U.S. documents it references.
- 55 This commitment had helped end the Cuban Missile Crisis. “Summary of Conclusions of a Special Coordination Committee Meeting,” November 14, 1978, in *Foreign Relations of the United States 1977–1980*, vol. XXIII, *Mexico, Cuba, and The Caribbean* (Washington, DC: Government Printing Office, 2016), document 38.
- 56 Arnold L. Horelick, “MIG-23s,” Memorandum for the Record, November 16, 1978, RDP06T01849R000100030028, CREST System, 1, <https://www.cia.gov/library/readingroom/docs/CIA-RDP06T01849R000100030028-2.pdf>. For Vance’s official talking points, see Department of State to Embassy Moscow, “Demarche to Soviets on MiG-23’s in Cuba,” Telegram 290640, November 16, 1978, 1978STATE290640, RDP06T01849R000100030029, CREST System, <https://www.cia.gov/library/readingroom/docs/CIA-RDP06T01849R000100030029-1.pdf>.
- 57 Director of Central Intelligence, “National Intelligence Daily,” March 7, 1979, RDP79T00975A031200060002, CREST System, 12, <https://www.cia.gov/library/readingroom/docs/CIA-RDP79T00975A031200060002-7.pdf>. Further MiG-23s exports in the early 1980s reignited the controversy.
- 58 Hans M. Kristensen, *Non-Strategic Nuclear Weapons*, Special Report 3 (Federation of American Scientists, May 2012), 70–74, <https://fas.org/docs/Non-Strategic-Nuclear-Weapons.pdf>.
- 59 Kristensen, *Non-Strategic Nuclear Weapons*, 74.
- 60 Hans M. Kristensen, “Russia Upgrades Nuclear Weapons Storage Site in Kaliningrad,” *Strategic Security* (blog), June 18, 2018, <https://fas.org/blogs/security/2018/06/kaliningrad/>.
- 61 Jervis, *Perception and Misperception in International Politics*, 117–202.
- 62 Roger Hilsman, *To Move a Nation: The Politics of Foreign Policy in the Administration of John F. Kennedy* (Garden City, NY: Doubleday & Company, 1967), 186–187.
- 63 Amos Tversky and Daniel Kahneman, “Judgment Under Uncertainty: Heuristics and Biases,” *Science* 185, no. 4157 (1974): 1128–1130.
- 64 Lawrence Freedman, *U.S. Intelligence and the Soviet Strategic Threat* (Boulder, CO: Westview Press, 1977), 79–80. Freedman labels this effect a “bureaucratic tendency,” but it is probably better explained as a psychological phenomenon given the weight of experimental evidence for anchoring.
- 65 Steven Zaloga, letter to the editor, *Cold War International History Project Bulletin*, nos. 12–13 (Fall/Winter 2001): 360.
- 66 Coleman, “The Missiles of November, December, January, February,” 18–19.
- 67 Ernest R. May and Philip D. Zelikow, eds., *The Kennedy Tapes: Inside the White House During the Cuban Missile Crisis*, concise edition (New York: W. W. Norton & Company: 2002), 425.
- 68 There is no single definitive proof of this claim; rather, many pieces of evidence, when taken together, paint a convincing picture. On Russian dual-use missiles, for example, see Sutyagin,

- Atomic Accounting*, 55. Dual-use Tu-160 bombers are based at only one site, the 6950th Guards Air Base in Engels (where nuclear weapons are almost certainly stored), strongly suggesting that those aircraft are available for both nuclear and nonnuclear operations. Tu-95MS bombers housed at the same base have been involved in nonnuclear operations (including striking targets in Syria with conventional Kh-101 cruise missiles), suggesting that they are similarly available for nuclear and nonnuclear operations. Hans M. Kristensen and Matt Korda, “Nuclear Upgrades at Russian Bomber Base and Storage Site,” *Strategic Security* (blog), February 25, 2019, <https://fas.org/blogs/security/2019/02/engels-saratov-nuclear-upgrades/>; Ministry of Defense of the Russian Federation, “Strategic Tu-95MS Bombers Destroyed the ISIS Militants’ Command Post and Storages in Syria With a Missile Attack,” press release, July 5, 2017, <http://syria.mil.ru/en/index/syria/news/more.htm?id=12132186@egNews>; and Pavel Podvig, “Strategic Aviation,” *Russian Strategic Nuclear Forces* (blog), June 20, 2017, <http://russianforces.org/aviation/>.
- 69 Hans M. Kristensen, “Flying Nuclear Bombs,” *Strategic Security* (blog), September 5, 2007, https://fas.org/blogs/security/2007/09/flying_nuclear_bombs/.
- 70 Sutyagin, *Atomic Accounting*, 9.
- 71 Russian Federation, “Practical Steps of the Russian Federation Towards Nuclear Disarmament,” 2015 Review Conference of the Parties to the Treaty on the Non-Proliferation of Nuclear Weapons, New York, April 27–May 22, 2015, 20, <http://www.pircenter.org/media/content/files/13/14319751051.pdf>.
- 72 For the origins of the U.S. policy, see Office of the Historian, Headquarters Strategic Air Command, *Alert Operations and The Strategic Air Command, 1957–1991* (Headquarters Strategic Air Command: Offutt Airforce Base, NE, December 7, 1991), 23–24, <https://www.afgsc.af.mil/Portals/51/Docs/SAC%20Alert%20Operations%20Lo-Res.pdf?ver=2016-09-27-114343-960>.
- 73 Daniel R. Coats, “Worldwide Threat Assessment of the U.S. Intelligence Community,” statement for the record, Office of the Director of National Intelligence, February 13, 2018, 13, <https://www.dni.gov/files/documents/Newsroom/Testimonies/2018-ATA--Unclassified-SSCI.pdf>; Defense Intelligence Agency, *Russia Military Power*, 36; and Air-Sea Battle Office, “Air-Sea Battle: Service Collaboration to Address Anti-Access & Area Denial Challenges,” May 2013, 7, <http://archive.defense.gov/pubs/ASB-ConceptImplementation-Summary-May-2013.pdf>.
- 74 In fact, because of the curvature of the earth, it may not even be possible to keep track of nonstealthy aircraft continuously.
- 75 On Russia’s use of inflatable decoys, albeit not for the purpose of protecting the specific weapons under discussion here, see Andrew E. Kramer, “A New Weapon in Russia’s Arsenal, and It’s Inflatable,” *New York Times*, October 12, 2016, <https://www.nytimes.com/2016/10/13/world/europe/russia-decoy-weapon.html>.
- 76 Fiona S. Cunningham and M. Taylor Fravel, “Assuring Assured Retaliation: China’s Nuclear Posture and U.S.–China Strategic Stability,” *International Security*, 40, no. 2 (Fall 2015): 42–44. On China’s practice of storing missiles and warheads separately, see Mark A. Stokes, *China’s Nuclear Warhead Storage and Handling System* (Project, 2049, March 12, 2010), 6, https://project2049.net/wp-content/uploads/2018/05/chinas_nuclear_warhead_storage_and_handling_system.pdf.
- 77 Office of the Secretary of Defense, *Military and Security Developments Involving the People’s Republic of China 2019*, 66. See also, Talmadge, “Would China Go Nuclear?,” 73–75.
- 78 1991 Strategic Arms Reduction Treaty (START), article VI.3.

- 79 Mark Stokes, *PLA Rocket Force Leadership and Unit Reference* (Project 2049 Institute, November 30, 2018), 4; Lewis, *Paper Tigers*, 116. The 611 and 612 brigades were, until recently, named the 807 and 811 brigades, respectively.
- 80 If the United States were unable to distinguish between nuclear- and conventionally armed variants of *different* missiles—such as conventional DF-15s and nuclear DF-21s—China’s nuclear and conventional missiles forces would be significantly more entangled.
- 81 Hans M. Kristensen, “Chinese DF-26 Missile Launchers Deploy to New Missile Training Area,” *Strategic Security* (blog), updated January 31, 2019, <https://fas.org/blogs/security/2019/01/df-26/>.
- 82 Second Artillery Corps, People’s Liberation Army, *The Science of Second Artillery Campaigns* (Beijing: PLA Press, 2004), 159.
- 83 Li Bin, “Tracking Chinese Strategic Mobile Missiles,” *Science & Global Security* 15, no. 1 (2007): 10–11. For the view that mating would be most likely to happen before deployment, see Lewis, *Paper Tigers*, 119.
- 84 For example, one interpretation of the data in Office of the Secretary of Defense, *Military and Security Developments Involving the People’s Republic of China 2019*, 117, is that conventional units may typically be assigned more missiles with which to reload their transporter-erector launchers than nuclear units. If so, the association of multiple missile transport vehicles with a single transporter-erector launcher may suggest those missiles are conventionally armed. For a description of the support vehicles involved in missile operations, see Dennis J. Blasko, *The Chinese Army Today: Tradition and Transformation for the 21st Century*, 2nd ed. (London: Routledge, 2012), 107.
- 85 Second Artillery Corps, *The Science of Second Artillery Campaigns*, 376–377 and 379–380.
- 86 Joshua H. Pollack, “Boost-Glide Weapons and U.S.-China Strategic Stability,” *Nonproliferation Review* 22, no. 2 (2015): 159; Lewis, *Paper Tigers*, 115 and 118; and Li, “Tracking Chinese Strategic Mobile Missiles,” 10.
- 87 Second Artillery Corps, *The Science of Second Artillery Campaigns*, 388.
- 88 Office of the Secretary of Defense, *Military and Security Developments Involving the People’s Republic of China 2019*, 51; and Avery Goldstein, “First Things First: The Pressing Danger of Crisis Instability in U.S.-China Relations,” *International Security* 37, no. 4 (Spring 2013): 67–68.
- 89 Jordan Wilson, *China’s Expanding Ability to Conduct Conventional Missile Strikes on Guam* (Washington, DC: U.S.-China Economic and Security Review Commission, 2016), 8, https://www.uscc.gov/sites/default/files/Research/Staff%20Report_China%27s%20Expanding%20Ability%20to%20Conduct%20Conventional%20Missile%20Strikes%20on%20Guam.pdf.
- 90 Erickson, “Academy of Military Science Researchers: ‘Why We Had to Develop the Dongfeng-26 Ballistic Missile.’”
- 91 Paul Slovic, Baruch Fischhoff, and Sarah Lichtenstein, “Rating the Risks” in *The Perception of Risk*, ed. Paul Slovic (Abingdon: Earthscan, 2000), 110–111. For similar behavior in business contexts, see James G. March and Zur Shapira, “Managerial Perspectives on Risk and Risk Taking,” *Management Science* 33, no. 11 (November 1987): 1407–1408.
- 92 Paul Rozin and Edward B. Royzman, “Negativity Bias, Negativity Dominance, and Contagion,” *Personality and Social Psychology Review* 5, no. 4 (2001): 298. See also, Dominic D. P. Johnson and Dominic Tierney, “Bad World: The Negativity Bias in International Politics,” *International Security* 43, no. 3 (Winter 2018/19): 102–109.

- 93 Johnson and Tierney, “Bad World,” 102–103. The negativity bias may have contributed, in the late 1950s, to the U.S. intelligence community’s exaggerated initial estimates of Soviet ICBM production capabilities. Freedman, *U.S. Intelligence and the Soviet Strategic Threat*, 79.
- 94 National Intelligence Estimate 11-5-61, Table IV.
- 95 May and Zelikow, eds., *The Kennedy Tapes*, 166.
- 96 Coleman, “The Missiles of November, December, January, February,” 41.
- 97 Director of Central Intelligence, *Soviet Gross Capabilities for Attack on the US and Key Overseas Installations and Forces Through Mid-1959*, National Intelligence Estimate 11-56, March 6, 1956, RDP79R01012A006500040001, CREST system, <https://www.cia.gov/library/readingroom/docs/CIA-RDP79R01012A006500040001-7.pdf>, 7.
- 98 May and Zelikow, eds., *The Kennedy Tapes*, 82, 117, 130, and 135.
- 99 Coleman, “The Missiles of November, December, January, February,” 16.
- 100 Timothy Naftali and Philip Zelikow, eds., *The Presidential Recordings: John F. Kennedy: The Great Crises, Volume 2, September–October 21, 1962* (New York: W. W. Norton & Company, 2001), 21.
- 101 May and Zelikow, eds., *The Kennedy Tapes*, 41. For McNamara’s and Taylor’s comments suggesting that the MiG-21s could also be armed with conventional warheads, see Naftali and Zelikow, eds., *The Presidential Recordings, Volume 2*, 439–440.
- 102 May and Zelikow, eds., *The Kennedy Tapes*, 58. Taylor hints at this again on page 65. Brief statements by McNamara and Taylor later in the crisis suggest that they did not change their views. These statements went unchallenged—though it is unclear whether the other principals had come to agree with McNamara and Taylor or simply decided the issue was not worth arguing about. See May and Zelikow, eds., *The Kennedy Tapes*, 82 and 135.
- 103 May and Zelikow, eds., *The Kennedy Tapes*, 49. Later the same day, Kennedy made the same argument, eliciting approval from Bundy and Secretary of State Dean Rusk. Naftali and Zelikow, eds., *The Presidential Recordings, Volume 2*, 440.
- 104 Daniel Ellsberg, “Risk, Ambiguity, and the Savage Axioms,” *Quarterly Journal of Economics* 75, no. 4 (November 1961): 643–669. For a review of the experimental evidence, see Stefan T. Trautmann and Gijs van de Kuilen, “Ambiguity Attitudes” in *The Wiley Blackwell Handbook of Judgment and Decision Making*, eds. Gideon Keren and George Wu (Chichester: John Wiley & Sons, 2015).
- 105 U.S. Department of Defense, *Nuclear Posture Review*, February 21, 2018, 44, <https://media.defense.gov/2018/Feb/02/2001872886/-1/-1/1/2018-NUCLEAR-POSTURE-REVIEW-FINAL-REPORT.PDF>.
- 106 This translation is from Michael S. Chase and Andrew S. Erickson, “The Conventional Missile Capabilities of China’s Second Artillery Force: Cornerstone of Deterrence and Warfighting,” *Asian Security* 8, no. 2 (2012): 123–124. See, more generally, Second Artillery Corps, *The Science of Second Artillery Campaigns*, ch. 10.
- 107 Laura Smith-Spark, Alla Eshchenko, and Emma Burrows, “Russia Was Ready to Put Nuclear Forces on Alert Over Crimea, Putin Says,” CNN, March 16, 2015, <https://www.cnn.com/2015/03/16/europe/russia-putin-crimea-nuclear/index.html>.
- 108 Todd S. Sechser and Matthew Fuhmann, *Nuclear Weapons and Coercive Diplomacy* (Cambridge: Cambridge University Press, 2017), 134–136.

- 109 Bruce G. Blair, *The Logic of Accidental Nuclear War* (Washington, DC: The Brookings Institution, 1993), 23–26. Blair’s focus is on alerts, which may be conducted for reasons other than signaling. However, assuming the description relayed to Blair is correct, the most likely explanation for the 1968 alert is signaling.
- 110 Thomas C. Schelling, *The Strategy of Conflict* (Cambridge, MA.: Harvard University Press, 1960), ch. 8.
- 111 Tong Zhao and Li Bin, “The Underappreciated Risks of Entanglement: A Chinese Perspective,” in *Entanglement*, 68.
- 112 Joint Chiefs of Staff, *Nuclear Operations*, Joint Publication 3-72, June 11, 2019, II-3. This document was removed from official websites shortly after being posted but is available from https://fas.org/irp/doddir/dod/jp3_72.pdf.
- 113 U.S. heavy bombers are based in Louisiana, Missouri, and North Dakota.
- 114 For a review of the history of nuclear signals, see Sechser and Furchmann, *Nuclear Weapons and Coercive Diplomacy*, chs. 5–6.
- 115 Scott D. Sagan and Jeremi Suri, “The Madman Nuclear Alert: Secrecy, Signaling, and Safety in October 1969,” *International Security* 27, no. 4 (Spring 2003): 176–179.
- 116 Sechser and Furchmann, *Nuclear Weapons and Coercive Diplomacy*, 135.
- 117 The desire to maintain flexibility runs contrary, of course, to the very purpose of signaling, which is to lock decisionmakers into a future course of action, albeit conditionally. However, politicians frequently want to have it both ways, partly because they may not decide in advance how they will react if a threat is ignored. A recipe for escalation would be a decisionmaker’s deciding that a vague threat was, in fact, meant seriously only after the other side appeared to have ignored it.
- 118 International relations theorists generally accept that the outbreak of war can be caused by miscalculations about an opponent’s willingness to fight. See, for example, James D. Fearon, “Rationalist Explanations for War,” *International Organization* 49, no. 3 (Summer 1995): 393–395. The argument here is an analogous one, in which the threshold in question is the use of nuclear weapons rather than the use of force. While Fearon stresses the rational incentives for states to underplay or exaggerate their resolve, misperceptions about resolve increase the risk of escalation regardless of their cause.
- 119 For a related discussion about a somewhat different type of misinterpreted warning, see Acton, “Escalation Through Entanglement,” 72–73.
- 120 Because the ambiguous weapons were not nuclear-armed, nonnuclear attacks directed solely against them would probably not represent a significant escalation. For more on the widespread use of dual-use command-and-control capabilities, see Acton, “Escalation Through Entanglement,” 63–66 and 78–82.
- 121 Blair, *The Logic of Accidental Nuclear War*, 23–26; and Scott D. Sagan, *The Limits of Safety: Organizations, Accidents, and Nuclear Weapons* (Princeton, NJ: Princeton University Press, 1993), 143–144.
- 122 Michael S. Gerson, *The Sino-Soviet Border Conflict: Deterrence, Escalation, and the Threat of Nuclear War in 1969* (Alexandria, VA: Center for Naval Analyses, 2010), 28–52, https://www.cna.org/CNA_files/PDF/D0022974.A2.pdf; and David M. Alpern with David C. Martin, “A Soviet War of Nerves,” *Newsweek* (January 5, 1981), 21.

- 123 This discussion was originally published in James M. Acton and Nick Blanchette, “The United States’ Nuclear and Non-Nuclear Weapons Are Dangerously Entangled,” *Foreign Policy*, November 12, 2019, <https://foreignpolicy.com/2019/11/12/the-united-states-nuclear-and-non-nuclear-weapons-are-dangerously-entangled/>.
- 124 For a summary of the evidence, see Sechser and Furchmann, *Nuclear Weapons and Coercive Diplomacy*, 222–223.
- 125 James Schlesinger, transcript of news conference, October 26, 1973, available from U.S. Department of State, *Bulletin* LXIX, vol. 1795 (Washington, DC: Government Printing Office, November 19, 1973), 621, <https://babel.hathitrust.org/cgi/pt?id=uiuo.ark:/13960/t8jd6fc91&view=1up&seq=705>.
- 126 Tim Naftali, “CIA Reveals Its Secret Briefings to Presidents Nixon and Ford,” CNN, August 26, 2016, <https://www.cnn.com/2016/08/26/opinions/secret-briefings-to-presidents-from-cia-naftali/>.
- 127 John W. Finney, “Officials Suspect Russians Sent Atom Arms to Egypt,” *New York Times*, November 22, 1973, 1.
- 128 William B. Quandt, “Soviet Policy in the October Middle East War—II,” *International Affairs* 53, no. 4 (October 1977): 596–597. See also, for example, Barry M. Blechman and Douglas M. Hart, “The Political Utility of Nuclear Weapons: The 1973 Middle East Crisis,” *International Security* 7, no. 1 (Summer 1982): 137.
- 129 Finney, “Officials Suspect Russians Sent Atom Arms to Egypt”; and Jeffrey T. Richelson, “Task Force 157: The U.S. Navy’s Secret Intelligence Service, 1966–77,” *Intelligence and National Security* 11, no. 1 (January 1996): 117–119. For other background, including the name of the Soviet freighter see CIA, “Soviet Nuclear Weapons in Egypt?,” memorandum, October 30, 1973, 1, <https://www.cia.gov/library/readingroom/docs/1973-10-30D.pdf>.
- 130 CIA, “The President’s Daily Brief,” October 26, 1973, RDP79T00936A0118600200103, CREST System, https://www.cia.gov/library/readingroom/docs/DOC_0005993967.pdf.
- 131 CIA, “Soviet Nuclear Weapons in Egypt?,” 1–2.
- 132 CIA, “Soviet Nuclear Weapons in Egypt?,” 5.
- 133 Richelson, “Task Force 157,” 119.
- 134 Victor Israelyan, *Inside the Kremlin During the Yom Kippur War* (University Park, PA: Pennsylvania State University Press, 1995), 191–192.
- 135 Blair, *The Logic of Accidental Nuclear War*, 25. On balance, the account by former Soviet official Victor Israelyan, neither supports nor contradicts Blair. Israelyan states that the Soviet Union “abstain[ed] from a military demonstration in response to” the U.S. alert, but the “preliminary command” described by Blair does not really constitute such a demonstration. Israelyan, *Inside the Kremlin During the Yom Kippur War*, 193. Moreover, it is unclear from Israelyan’s account whether defense minister Andrei Grechko or a subordinate needed (or, indeed, sought) Politburo permission to issue a preliminary command. If not, Israelyan would likely not have known about it.
- 136 Talmadge, “Would China Go Nuclear?,” 73–75; Wu, “Sino-U.S. Inadvertent Escalation,” 5–6 and 7–8.
- 137 Cunningham and Fravel, “Assuring Assured Retaliation,” 22. See also Talmadge, “Would China Go Nuclear?,” 84–90.

- 138 For the U.S. Department of Defense’s concerns about “ambiguity surrounding the circumstances under which China’s no-first-use policy would apply,” see Office of the Secretary of Defense, *Military and Security Developments Involving the People’s Republic of China 2019*, 66.
- 139 For more on a launch-under-attack alert, see Kulacki, *The Chinese Military Updates China’s Nuclear Strategy*, 4.
- 140 May and Zelikow, eds., *The Kennedy Tapes*, 364. On October 27, the Joint Chiefs called for such airstrikes no later than October 29 (see page 351). See page 443 for May and Zelikow’s assessment of the likelihood of military action.
- 141 Coleman, “The Missiles of November, December, January, February,” 8–12.
- 142 Coleman, “The Missiles of November, December, January, February,” 15.
- 143 Others may also be trying to use warhead ambiguity to their advantage, potentially for somewhat different reasons. North Korea has a large force of regional ballistic missiles, many of which may be dual-use (see appendix). However, because of limitations in fissile material, probably only a small fraction of them could be armed with nuclear warheads. Unless the United States could quickly and reliably identify which of these missiles were nuclear-armed, this arrangement would likely make it more difficult for Washington to eliminate Pyongyang’s nuclear arsenal in a crisis or conflict—but whether this kind of shell game is a happy accident, from the North Korean perspective, or the result of a deliberate strategy is unclear.
- 144 Other pathways for acquiring dual-use delivery systems are possible. For example, a state could acquire a delivery system for one purpose and then later make it dual-use.
- 145 Amos Tversky and Daniel Kahneman, “Availability: A Heuristic for Judging Frequency and Probability,” *Cognitive Psychology* 5, no. 2 (1973): 207–232. The use of the availability heuristic seems likely here because there is no obvious “initial value” that can be adjusted (unlike, say, the task of estimating the value of a stock in a year’s time, in which case its current value provides the obvious starting point).
- 146 Colin F. Camerer and Howard Kunreuther, “Decision Processes for Low Probability Events: Policy Implications,” *Journal of Policy Analysis and Management* 8, no. 4 (1989): 569.
- 147 To compound this problem, if decisionmakers are unaware of the risks associated with pre-launch warhead ambiguity—a danger that has attracted little attention, at least in open sources—they will be unable to compensate for the lack of historical instances of inadvertent escalation with imagined examples.
- 148 Paul Slovic, Baruch Fischhoff, Sarah Lichtenstein, Bernard Corrigan, and Barbara Combs, “Preference for Insuring Against Probable Small Losses: Insurance Implications,” *Journal of Risk and Insurance* 44, no. 2 (June 1977): 237–258. Similar behavior has also been observed among corporate managers. March and Shapira, “Managerial Perspectives on Risk and Risk Taking,” 1411.
- 149 For a general discussion of the challenges associated with implementing cost-benefit analyses, see Baruch Fischhoff, Paul Slovic, and Sarah Lichtenstein, “Weighing the Risks: Which Risks Are Acceptable?” in *The Perception of Risk*, 122–125.
- 150 S. O’Mahony, “Medicine and the McNamara Fallacy,” *Journal of the Royal College of Physicians of Edinburgh* 47, no. 3 (September 2017): 281–287; Kenneth Cukier and Viktor Mayer-Schönberger, “The Dictatorship of Data,” *MIT Technology Review* (May 31, 2013), <https://www.technologyreview.com/s/514591/the-dictatorship-of-data/>; and Paul Slovic, Howard Kunreuther, and Gilbert F. White, “Decision Processes, Rationality and Adjustment to Natural Hazards” in *The Perception of Risk*, 20. The origin of this term is unclear, but the earliest exposition of the concept appears to be “Adam Smith” (pseudonym), “The Last Days of Cowboy Capitalism,” *Atlantic Monthly* (September 1972): 54.

- 151 Alan M. Jacobs, “Policy Making for the Long Term in Advanced Democracies,” *Annual Review of Political Science* 19 (2016): 439.
- 152 Ideally, a requirement to consider escalation risks should apply to all acquisition decisions, but it is particularly important in this case.
- 153 Putin, “Presidential Address to the Federal Assembly.”
- 154 U.S. Department of Defense, *Missile Defense Review*, 2019, 31, <https://media.defense.gov/2019/Jan/17/2002080666/-1-1/1/2019-MISSILE-DEFENSE-REVIEW.PDF>.
- 155 Unlike the United States, both China and Russia field shorter-range dual-use missiles. Moreover, there is evidence of Chinese and particularly Russian interest in conventional intercontinental boost-glide systems. James M. Acton, “Russia and Strategic Conventional Weapons: Concerns and Responses,” *Nonproliferation Review* 22, no. 2 (2015): 147–148; and Mark Stokes, *China’s Evolving Conventional Strategic Strike Capability: The Anti-Ship Ballistic Missile Challenge to U.S. Maritime Operations in the Western Pacific and Beyond* (Project 2049 Institute, September 14, 2009), 10, https://project2049.net/wp-content/uploads/2018/06/chinese_anti_ship_ballistic_missile_asbm.pdf. Given that both states are concerned about the potential impact of U.S. ballistic missile defenses on their nuclear deterrents, they have clear incentives to develop dual-use intercontinental boost-glide systems eventually.
- 156 For example, Anatoly Antonov, “Russia Forced to Develop Global Prompt Strike Weapons,” *Security Index* 19, no. 3 (2013): 6–7. See also, Acton, “Russia and Strategic Conventional Weapons,” 146.
- 157 SSBNs have occasionally been used for signaling in peacetime by conducting publicized port calls. Because the ICBM force is kept on alert, there is much less flexibility in how it is postured, making it significantly less useful for signaling.
- 158 The risk would not be zero, however, as SSBNs might be mistaken for SSGNs, which are SSBNs that have been modified to carry nonnuclear cruise missiles instead of nuclear-armed ballistic missiles.
- 159 Chinese and Russian decisionmakers face a similar dilemma. Their states’ only missiles that are reserved exclusively for nuclear operations have intercontinental ranges (though, Russian capabilities, in particular, are very murky). As a result, in issuing nuclear signals, Beijing and Moscow would most likely choose between using ambiguous shorter-range missiles (or perhaps ambiguous aircraft) and mobile ICBMs that carry only nuclear warheads. Once again, a trade-off between different types of risk would arise. Signals sent with mobile ICBMs would carry less risk of being misinterpreted but, because of the potential reach of ICBMs, could be more aggressive than desired.
- 160 The development of longer-range missiles could plausibly foment a deterrence relationship between Israel and Pakistan in the not-too-distant future. However, for the time being, deficiencies in Pakistani (and perhaps Israeli) ISR capabilities would mitigate the risks associated with pre-launch warhead ambiguity.
- 161 For an overview of French capabilities, see Hans M. Kristensen and Matt Korda, “French Nuclear Forces, 2019,” *Bulletin of the Atomic Scientists* 75, no. 1 (2019): 51–55.
- 162 Bruno Tertrais, *French Nuclear Deterrence Policy, Forces and Future* (Paris: Fondation Pour La Recherche Stratégique, January 2019), 64 and 65, <https://www.frstrategie.org/web/documents/publications/recherches-et-documents/2019/201901.pdf>.
- 163 Christopher Clary and Vipin Narang, “India’s Counterforce Temptations: Strategic Dilemmas, Doctrine, and Capabilities,” *International Security* 43, no. 3 (Winter 2018/19): 26; and Hans M. Kristensen and Matt Korda, “Indian Nuclear Forces, 2018,” *Bulletin of the Atomic Scientists* 74, no. 6 (2018): 363.

- 164 Pakistan may soon deploy a dual-use air-launched cruise missile, *Ra'ad (Hatf-8)*, though it will not contribute directly to pre-launch warhead ambiguity. Hans M. Kristensen, Robert S. Norris, and Julia Diamond, "Pakistani Nuclear Forces, 2018," *Bulletin of the Atomic Scientists* 74, no. 5 (2018): 355.
- 165 Agence France Presse, "India Tests Nuclear-Capable Missile, Surprises Analysts," March 26, 2003.
- 166 Kristensen and Korda, "Indian Nuclear Forces, 2018," 363.
- 167 Clary and Narang, "India's Counterforce Temptations," 29. See also the discussion of the longer-range *Shouyra* missile.
- 168 See, for example, Feroz Hassan Khan, *Going Tactical: Pakistan's Nuclear Posture and Implications for Stability*, Proliferation Papers 53 (Paris: Ifri, September 2015), 34, https://www.ifri.org/sites/default/files/atoms/files/pp53khan_0.pdf.
- 169 Kristensen, Norris, and Diamond, "Pakistani Nuclear Forces, 2018," 353–354; and Director-General, Inter-Services Public Relations, Twitter post, November 18, 2019, 3:22am, <https://twitter.com/OfficialDGISPR/status/1196342816777084929>.
- 170 Khan, *Eating Grass*, 237–238.
- 171 Khan, *Eating Grass*, 249.
- 172 Defense Intelligence Ballistic Missile Analysis Committee, *Ballistic and Cruise Missile Threat 2017*, 37. See also, Khan, *Eating Grass*, 247. Additionally, official Pakistani sources have implied that an improved version of this missile, currently under development, is dual-use. Kristensen, Norris, and Diamond, "Pakistani Nuclear Forces, 2018," 355.
- 173 Clary and Narang, "India's Counterforce Temptations," 30; and Defense Intelligence Ballistic Missile Analysis Committee, *Ballistic and Cruise Missile Threat 2017*, 37. An Indian ground-launched cruise missile, *Nirbhay*, that is also under development may be dual-use. Kristensen and Korda, "Indian Nuclear Forces, 2018," 365.
- 174 Christopher Clary and Ankit Panda, "Safer at Sea? Pakistan's Sea-Based Deterrent and Nuclear Weapons Security," *The Washington Quarterly* 40, no. 3 (Fall 2017): 156. See also page 149 for the suggestion that the missile will be dual-use.
- 175 Kristensen and Korda, "Indian Nuclear Forces, 2018," 365.
- 176 Personal communication, Toby Dalton, November 2019. For Pakistani concerns about an "asymmetry" in ISR capabilities, see Mansoor Ahmed, "Pakistan's Tactical Nuclear Weapons and Their Impact on Stability," *Regional Insight*, Carnegie Endowment for International Peace, June 30, 2016, <https://carnegieendowment.org/2016/06/30/pakistan-s-tactical-nuclear-weapons-and-their-impact-on-stability-pub-63911>.
- 177 Clary and Narang, "India's Counterforce Temptations," 31–34.
- 178 North Korean statements that tests of the HS-12 were conducted by Hwasong Artillery units further suggest (for reasons discussed below) that this missile is exclusively nuclear-armed. See, for example, KCNA, "Kim Jong Un Guides Strategic Ballistic Rocket Launching Drill of KPA Strategic Force," August 30, 2017, <https://kcnawatch.org/newstream/1504044160-212341135/kim-jong-un-guides-strategic-ballistic-rocket-launching-drill-of-kpa-strategic-force/?t=1573847540317>.
- 179 Joshua Pollack, personal communication, November 2019.

- 180 Joshua Pollack, personal communication, November 2019; and see, for example, KCNA, “Supreme Leader Kim Jong Un Watches Demonstration Fire of New-Type Tactical Guided Missiles,” August 7, 2019, <https://kcnawatch.org/newstream/1565332217-70577589/supreme-leader-kim-jong-un-watches-demonstration-fire-of-new-type-tactical-guided-missiles/?t=1574043719125>. The Scud-B, Scud-C, and Nodong are particularly likely to be dual-use because they were acquired before North Korea’s acquisition of nuclear weapons.
- 181 KCNA, “Kim Jong Un Supervises Ballistic Rocket Launching Drill of Hwasong Artillery Units of KPA Strategic Force,” March 7, 2017, <https://kcnawatch.org/newstream/270276/kim-jong-un-supervises-ballistic-rocket-launching-drill-of-hwasong-artillery-units-of-kpa-strategic-force/>. For contrary analysis that suggests the KN-23 may be dual-use, see Jeffrey Lewis, “Preliminary Analysis: KN-23 SRBM,” James Martin Center for Nonproliferation Studies, June 5, 2019, <https://www.nonproliferation.org/preliminary-analysis-kn-23-srbm/>.

CARNEGIE ENDOWMENT FOR INTERNATIONAL PEACE

The Carnegie Endowment for International Peace is a unique global network of policy research centers in Russia, China, Europe, the Middle East, India, and the United States. Our mission, dating back more than a century, is to advance peace through analysis and development of fresh policy ideas and direct engagement and collaboration with decision-makers in government, business, and civil society. Working together, our centers bring the inestimable benefit of multiple national viewpoints to bilateral, regional, and global issues.

NUCLEAR POLICY PROGRAM

The Carnegie Nuclear Policy Program is an internationally acclaimed source of expertise and policy thinking on nuclear industry, nonproliferation, security, and disarmament. Its multinational staff stays at the forefront of nuclear policy issues in the United States, Russia, China, Northeast Asia, South Asia, and the Middle East.



CarnegieEndowment.org