Reducing nuclear weapons risk

Behavioural insights and the human factor in nuclear decision-making

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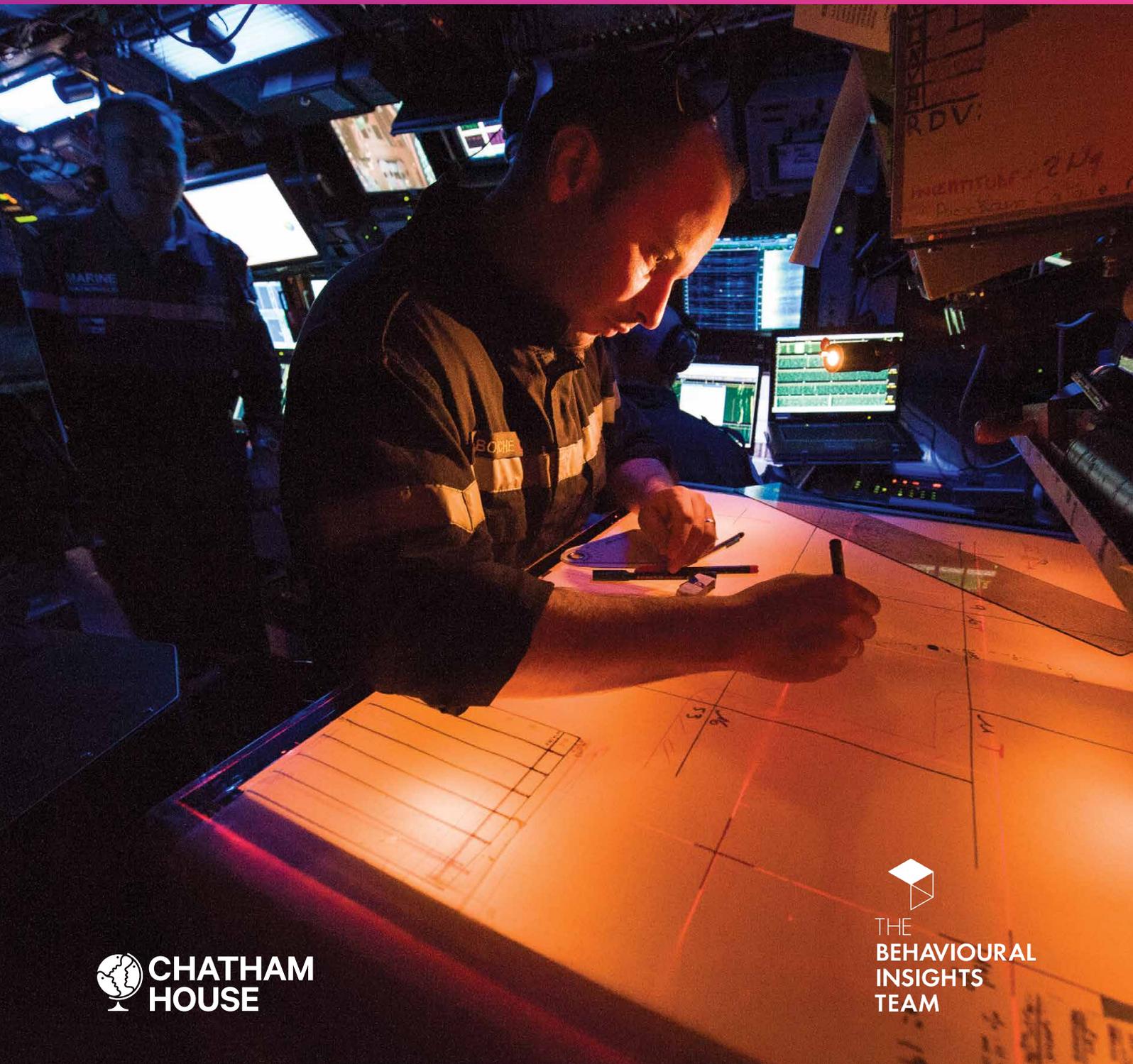
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Summary

— Behavioural insights have helped improve the choice architecture in policy environments such as personal finance and public health. As nuclear weapons risks rise globally, behavioural insights have the potential to contribute significantly to the vital task of improving nuclear decision-making.

— This research paper highlights four aspects of nuclear weapons policy in which behavioural insights could be relevant and useful: reducing overconfidence among decision-makers; addressing concerns about miscommunication in nuclear decision-making; minimizing errors in nuclear policy implementation; and increasing public and political engagement.

— Overconfidence can lead to reckless decision-making, underestimation of the consequences of avoiding arms control efforts, denial over the safety and reliability of nuclear weapons and assumptions that adversaries share the same perspectives. This paper argues that overconfidence can be regulated and readjusted through exercises such as 'premortems', calibration, simulations, 'red-teaming' and reframing.

— In times of crisis, heightened tensions and mistrust can lead to miscommunication between nuclear weapons states, which in turn increases the risk of escalation. Such risk is growing due to evolving technology, cyber activities, disinformation campaigns, the emergence of new nuclear-armed actors and increased uncertainty in crisis situations. Miscommunication in nuclear weapons policy can be reduced through perspective rotations, improved internal communication, the use of mediators and redundancy planning.

— Errors involving nuclear weapons can arise for multiple reasons – including technical malfunctions, procedural failures and human factors – and the risk of human error is always present, regardless of how rigorous safety measures may be. Depending on whether an 'error' is a rule-based mistake, a knowledge-based mistake or an action-based slip, the likelihood of it occurring can be reduced through receiver operating characteristic curves, opportunities for correction and learning, improved personnel well-being policies and hierarchies of hazard controls.

— Public and political salience regarding nuclear weapons interact in complex ways. A variety of factors, including the media, global events and prevailing political narratives, can shape public opinion on nuclear weapons. Public awareness can lead to changing views among policymakers, often influenced by cultural, economic, historical and even religious factors. Behavioural insights show that both public and political engagement can be increased by using film and media, encouraging transparency of previously classified information and providing relatable and visual reminders of the real-world impact of nuclear weapons use.

Introduction

Nuclear risks are rising globally. The Russian invasion of Ukraine in February 2022 provides a stark reminder of how quickly tensions between governments can turn into war. Advances in psychology and neuroscience now allow for a much better understanding of human decision-making, especially under high-stress conditions.[1] Policymakers in some areas – such as healthcare, social security or taxation – have already begun to incorporate these learnings into how decisions are made, how leaders are trained and how policy changes are communicated to the public. But nuclear weapons policy has so far remained fairly insulated from this discussion. As part of Chatham House's programme of work on complexity in nuclear decision-making, this research paper explores the implications of behavioural insights for nuclear policy and decision-making.

Shortcomings in human decision-making across fields from personal finance to health are well documented. Humans are easily swayed by short-term gains over long-term ones; they tend to take the easiest option available and are inclined to follow social norms. Policymakers as individuals, and institutions that bring together individual preferences and biases, unsurprisingly also demonstrate these behaviours.

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The field of behavioural insights attempts to address some of these shortcomings. It has focused on interventions targeting general populations, such as in climate change, economics and public health, as well as on improving decision-making environments to achieve better outcomes. For instance, the introduction of default enrolment into workplace pension schemes in the UK drastically increased pension savings among those not previously saving for retirement.[2] There is a growing interest in understanding how behavioural insights can be applied by policymakers and their institutions to help develop solutions to the behavioural shortcomings that might impede effective decision-making in other areas.[3] Indeed, the role

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1 Kahneman, D. (2012), 'Of 2 Minds: How Fast and Slow Thinking Shape Perception and Choice [Excerpt]', *Scientific American*, 15 June 2012, https://www.scientificamerican.com/article/kahneman-excerpt-thinking-fast-and-slow.
2 Hardcastle, R. (2012), *How can we incentivise pension saving? A behavioural perspective*, working paper, London: UK Department of Work and Pensions, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/214406/WP109.pdf.
3 Hallsworth, M., Egan, M., Rutter, J. and McCrae, J. (2018), *Behavioural Government: Using behavioural science to improve how governments make decisions*, report, London: The Behavioural Insights Team, 11 July 2018, https://www.bi.team/publications/behavioural-government.

of institutions as 'behaviour change machines' – designed to shape the behaviour of those working within, or interacting with, them to achieve institutional goals – is growing as practitioners search for the most effective policy solutions.[4]

In nuclear weapons policy, the concept of the 'rational actor' continues to hold a great deal of power. The security of the international system in the nuclear age has rested on theories of nuclear deterrence developed in the early Cold War that are believed to work if leaders behave rationally.[5] The rational actor model assumes that decision-makers will make choices after careful deliberation of their full suite of options and then choose the pathway that best aligns with their objectives.[6] But critiques of rational actor theories have pointed out that incomplete information environments and psychological factors pose challenges to the assumption of the rational and clear-headed leader who operates with complete information and is capable of making calm decisions in a crisis.[7]

There are numerous factors which make good decision-making in nuclear weapons policy particularly difficult. Nuclear weapons policy features, on the one hand, decades-long struggles to ratify treaties and ensure compliance and, on the other, the most acute time pressures surrounding crisis decision-making with civilization-defining consequences. Neither of these extremes are optimal for human decision-making. The stakes are extremely high and the opportunity for learning and practice low. Most challenging of all, nuclear weapons policy necessarily operates internationally, requiring policymakers to communicate across cultural and linguistic barriers to reach a common understanding and get close to a shared form of rationalism.

Despite these immense challenges, this paper is intended to provide a constructive basis for discussion about where positive changes in nuclear decision-making at all levels may be possible. As has been demonstrated in other policy areas, an empirical approach to human behaviour can be used to better understand failings and to find ways to work around them. Each of the paper's four sections covers facets of nuclear policy where both the room for growth and the appetite to do better have been identified. One feature of behavioural insights is that it points to a wider mindset shift about how to approach decision-making across all levels of policy, whether in the initial stages of policymaking or in implementation. Each section concludes with recommendations that could be implemented across different levels of the nuclear policy apparatus, as well as ideas and case studies of how such changes could be made.

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4 Van den Heuvel, M. et al. (2020), 'How do Employees Adapt to Organizational Change? The Role of Meaning-making and Work Engagement', *The Spanish Journal of Psychology*, December 2020, 23(56), https://doi.org/10.1017/SJP.2020.55.

5 Alden, C. (2017), 'Critiques of the rational actor model and foreign policy decision making', in Thompson, W. R. and Capelos, T. (eds) (2017), *Oxford Research Encyclopedia of Politics*, Oxford: Oxford University Press, https://eprints.lse.ac.uk/84466/1/Alden_Critiques%20of%20rational%20actor_2017.pdf.

6 Carlsnaes, W., Risse, T. and Simmons, B. (2013), *Handbook of International Relations*, London: Sage.

7 Lebow, R. and Stein, J. (1989), 'Rational Deterrence Theory: I Think, Therefore I Deter', *World Politics,* 41(2), pp. 208–24, https://doi.org/10.2307/2010408; Borrie, J. (2020), 'Human Rationality and Nuclear Deterrence' in Unal, B., Afina, Y. and Lewis, P. (eds) (2020), *Perspectives on Nuclear Deterrence in the 21st Century*, Research Paper, London: Royal Institute of International Affairs, https://www.chathamhouse.org/2020/04/perspectives-nuclear-deterrence-21st-century. See also earlier works that critique rational actor theory and attempt to reconcile rational and non-rational approaches, including Simon, H. A. (1997), *Models of Bounded Rationality: Empirically Grounded Economic Reason, Volume 3*, Cambridge, MA: The MIT Press.

Methodology

This project used a qualitative research methodology, consulting with 35 former officials and experts from 13 different countries covering a wide range of different positions on nuclear policy. The group was consulted in three ways: in a group setting, testing and discussing ideas and case studies; through in-depth research interviews with a selected sub-group of former officials from different nuclear weapons states, delving into detailed questions on nuclear decision-making; and by asking a separate sub-group of former officials for detailed feedback on an earlier draft of this paper.

To narrow down the wide range of potential nuclear policy areas to the four areas discussed in this paper, the project team convened an initial scoping roundtable in May 2022 that brought together policymakers and experts from 14 different countries representing a wide range of policy positions on nuclear policy. The roundtable discussion answered initial questions about the concept of behavioural insights and explored initial areas of nuclear decision-making where they might be applied. Following the roundtable, the project team conducted additional desk research and expert consultations to investigate the most promising areas to explore in greater detail. The project team conducted eight in-depth consultations ranging in length between one and two hours. The eight people consulted were former officials from nuclear-armed states who had spent their careers in the nuclear decision-making architecture and had held high-level decision-making positions. The consultations provided insight into several decades of nuclear decision-making, and allowed the project team to identify areas of agreement or disagreement, as well as areas in which the experts thought there was room for improvement in decision-making structures or mechanisms. This series of consultations was supplemented by a feedback workshop with a larger group of experts – comprising 10 former officials and experts, representing eight different countries – to review an early draft of this paper.

Following the research and consultation phase, the list of topics for inclusion was narrowed down to four:

— **Overconfidence.** Several of those consulted cited examples from their own careers of when overconfidence had posed a problem in certain areas of nuclear policy. Examples mentioned included absolutist beliefs in both the strength of deterrence and the ability to control escalation in the event of conflict. The relevant section includes ways to improve how decision-makers assess their state's policies and capabilities to avoid overconfidence.

— **Miscommunication.** Everyone consulted expressed concern regarding the ability of policymakers to communicate clearly the intent of nuclear decisions. Clear signalling and communication are perennial security policy challenges, especially during times of heightened international tension. The section discussing miscommunication introduces some best practice recommendations, as well as new behavioural insights to help improve the clarity of communication.

— **Errors.** The US experts in the sample group were able to point to US government learning from past errors as one way to improve nuclear policy implementation. However, not all nuclear weapons states have been equally transparent about how they have addressed similar challenges. Experts from other states pointed out that it was important to be specific to the political and strategic context of each state, as those states differ in the extent to which they have implemented some of the recommendations in this section. This section shares best practice for dealing with nuclear safety and security, and discusses the value of transparency.

— **Public and political salience.** UK and US experts both highlighted the relationship between public and political salience, pointing to cases of treaty ratification in which public mobilization helped sway elected officials' positions, or in which protests played a role in influencing policy. This point is particularly important at a time when public awareness of nuclear weapons risks was rising again, due to Russia's nuclear threats against Ukraine. The relevant section includes possible strategies for engaging both the public and politicians on nuclear issues.

In addition to the individual and group consultations outlined above, the project team used extensive desk research and case studies to identify areas where behavioural insights could be applied. As behavioural insights are intended to make the choice architecture of decision-makers more transparent, the tools suggested in this paper could potentially be applied to other cases.

Limitations

Discussing the methodology also requires transparency over limitations. One of the project's main limitations is the small number of well-documented, unclassified cases in which policymakers' struggles with nuclear decision-making can be studied closely. Thanks to a range of declassified documents on both the Soviet and US sides, the Cuban missile crisis of 1962 has become the go-to case for studying various aspects of nuclear crisis decision-making. The thoroughness of the documentation available, the duration of the crisis and its varied components make it a useful case study.

However, it is important to acknowledge that lessons from the Cuban missile crisis cannot be overgeneralized. The episode must be seen in context: it was one of the first nuclear crises, taking place when the Soviet Union and the US were still defining many aspects of their relations and the implications of their nuclear-armed status. It was also specific to the political moment, marked partly by the make-up of both governments and partly by the interpersonal relationship between Soviet premier Nikita Khrushchev and US president John F. Kennedy. The leaders' personalities, previous interactions and assumptions about each other played a large role in how the negotiations unfolded. The states' military capabilities were also a significant factor: both states have since pursued parity policies and expanded their nuclear arsenals in ways that affect their deterrence relationship. Other nuclear crises would therefore look different in terms of advisers' concerns about second-strike capabilities.

It must be noted that the dynamics between countries and different regional contexts are complex and culture-specific, and the particularities of each nuclear weapons state must be considered. The decision-making of the Cuban missile crisis cannot therefore simply be expanded into a 'how to' guide to preventing future nuclear crises.

Several of the recommendations in this paper assume that those making certain nuclear decisions can be trained to improve their resilience to stress or, simply, to make better decisions. Some former officials consulted for this project recounted the difficulties they had encountered when trying to train high-level officials, who sometimes had the attitude that they did not require additional training. The former officials consulted made the point that it would be easier to implement the training requirements at lower levels of government, and to put in place incentives to engage senior decision-makers. Such incentives could include access to the highest-level decision-maker or time spent with their peers that they would not want to miss out on. These insights point to the role of culture in implementing recommendations: if a certain institutional culture considers training or feedback to be a weakness rather than a strength, or believes training to be unnecessary beyond a certain level of seniority, that culture makes change difficult to achieve. Further research could compare institutional cultures across different nuclear weapons states as potential catalysts or inhibitors for change.

Overconfidence

Overconfidence in nuclear weapons policy refers to the tendency of policymakers and decision-makers to overestimate their own country's military capabilities, while underestimating the consequences of decisions such as not engaging in arms-control efforts.[8] This phenomenon can lead to reckless policies and strategies that heighten the risk of nuclear conflict. Overconfidence can manifest in a variety of ways, from the underestimation of the potential for miscalculation to even the accidental use of nuclear weapons. The dangers of overconfidence in nuclear weapons policy have been demonstrated in historical examples of near nuclear use, such as the Cuban missile crisis, and remain a significant concern in contemporary global affairs.[9]

Possible examples of overconfidence in nuclear weapons policy include believing that 'tactical' nuclear weapons are usable and that nuclear escalation could be controlled during a crisis.[10] It can also mean assuming that adversaries have the same perspective or assess situations in the same way. This was made evident in Kofman's work that highlighted how drastically Russian perspectives

8 For further reading on overconfidence in nuclear weapons policy, and specifically in the manageability of nuclear crises, see Pelopidas, B. (2017), 'The unbearable lightness of luck: Three sources of overconfidence in the manageability of nuclear crises', *European Journal of International Security,* 2(2), pp. 240–62, https://doi.org/10.1017/eis.2017.6.
9 Lewis, P., Williams, H., Pelopidas, B. and Aghlani, S. (2014), *Too Close for Comfort: Cases of Near Nuclear Use and Options for Policy*, Research Paper, London: Royal Institute of International Affairs, https://www.chathamhouse.org/sites/default/files/field/field_document/20140428TooCloseforComfortNuclearUseLewisWilliamsPelopidasAghlani.pdf.
10 Kristensen, H. M. and Korda, M. (2019), 'Tactical nuclear weapons, 2019', *Bulletin of Atomic Scientists,* 75(5), pp. 252–61, https://doi.org/10.1080/00963402.2019.1654273.

on military strategy differed from those of the US, using the example of the US concept of anti-access and area denial (A2/AD) that has been used to analyse a 'Russian doctrine or strategy for warfighting that frankly does not exist'.[11]

One of the most notable instances of overconfidence in nuclear weapons policy occurred during the Cuban missile crisis.[12] The Soviet Union and the US engaged in a high-stakes game of brinkmanship that nearly resulted in a nuclear war. Both sides initially believed that its nuclear arsenal could deter the other from launching a first strike. However, this confidence rested on incomplete intelligence about the other's intentions and capabilities, as well as misunderstandings over the potential for miscalculation. Soviet and US leaders only reached a turning point in the crisis when each became increasingly concerned about being unable to control escalation. The crisis highlighted the dangers of overconfidence founded in incomplete intelligence and lack of control, and underscored the need for cautious and deliberate decision-making in nuclear policy.

The risk of overconfidence in nuclear weapons policy extends beyond intentional actions. Accidental or unintentional use of nuclear weapons is also a significant concern.

The risk of overconfidence in nuclear weapons policy extends beyond intentional actions. Accidental or unintentional use of nuclear weapons is also a significant concern. Overconfidence in the safety and reliability of nuclear weapons could lead to complacency and a failure to take necessary precautions. This, in turn, could increase the risk of accidental nuclear war and errors in nuclear weapons policy.[13] Experts consulted also noted how overconfidence can extend to nuclear signalling and the interpretation of that signalling, which can lead to unnecessary escalations and potential conflicts. Nuclear systems are highly complex and tightly coupled, which introduces an additional layer of risk.[14] In such situations, accidents can result from inherent system complexities, where the interactions between components are so interdependent that errors or failures in one area can cascade and lead to catastrophic outcomes in other areas. To visualize this concept, James Reason argues that levels of complex systems align like slices of 'Swiss cheese'.[15] Within each level (or 'slice') of the system, there are inherent weaknesses or vulnerabilities, represented by holes in the cheese. If the holes of each slice align, the safeguards present at each level of the system all independently fail, leading to a system-wide accident.

11 Kofman, M. (2019), 'It's Time to Talk About A2/AD: Rethinking the Russian Military Challenge', War on the Rocks, 5 September 2019, https://warontherocks.com/2019/09/its-time-to-talk-about-a2-ad-rethinking-the-russian-military-challenge.
12 Lewis, P., Aghlani, S., Pelopidas, B. and Williams, H. (2016), '12 Times We Came Close to Using Nuclear Weapons', Chatham House Expert Comment, 18 July 2016, https://www.chathamhouse.org/2016/07/12-times-we-came-close-using-nuclear-weapons.
13 See section on 'Errors' for further discussion on this topic.
14 See Perrow, C. (1999), *Normal Accidents: Living with High Risk Technologies*, updated edition, Princeton, NJ: Princeton University Press.
15 See SkyBRARY (2023), 'Swiss Cheese Model', https://skybrary.aero/articles/james-reason-hf-model.

Tools and solutions

In his seminal work *Expert Political Judgement*, Philip Tetlock shows that experts are often highly overconfident – and wrong – in their efforts to predict future events. In policymaking, this overconfidence can cause decision-makers to enact unrealistic plans or take excessive risks,[16] leading to failure – for example, an infrastructure project going massively over-budget, or a government being blindsided by unexpected opposition to a new policy.[17] Similar manifestations of overconfidence, termed the 'planning fallacy',[18] have been observed on numerous occasions in international security, including in the Russian invasion of Ukraine in 2022, in which the Russian government expected to achieve its goals much more easily than was the case in reality. When actors realize their mistake, they often continue on the wrong course due to the 'sunk-cost fallacy' – i.e. the desire to avoid their investment in resources and human lives being for nothing[19] – making them dangerous actors in the international system. As the theory of loss aversion shows, when individuals perceive themselves to be in the domain of losses (for example, losing an armed conflict), they become more risk-seeking in their behaviour.[20] In conflicts involving nuclear weapons states, such behaviour risks a conflict escalating to the nuclear level.

In the field of nuclear decision-making itself, where the possibility of learning from mistakes in calibration is limited, overconfidence can have catastrophic consequences. As identified in expert interviews for this paper, overconfidence may be an issue for those in key positions within nuclear decision-making structures. However, it is important to note that the level of overconfidence can vary widely among individuals, regardless of their profession. Norbert Schwartz's findings suggest that when individuals feel powerful – or even if they are simply reminded of an earlier time when they felt powerful – they demonstrate higher levels of trust in their intuition.[21] This tendency could bias individuals towards acting in line with their intuition or their moral or religious convictions, rather than following considered, slow and cross-institutional deliberation. One illustrative example comes from the Cuban missile crisis, when President Kennedy's military advisers continually pushed for a full-scale invasion of Cuba, despite the potential for nuclear confrontation with the Soviet Union and despite calls for restraint from US defence secretary Robert McNamara.[22] The advisers' attitude arose from a belief that the US armed forces could overpower the Cuban military and an underestimation of the number of Soviet troops stationed in Cuba.[23]

16 Hallsworth, M. and Egan, M. (2018), 'Are you well-calibrated? Results from a survey of 1,154 BIT readers', The Behavioural Insights Team, 21 May 2018, https://www.bi.team/blogs/are-you-well-calibrated-results-from-a-survey-of-1154-bit-readers.
17 Easterday, R. T. (2023), 'The Fallacy of the Short, Sharp War: Optimism Bias and the Abuse of History', The Strategy Bridge blog, 16 March 2023, https://thestrategybridge.org/the-bridge/2023/3/16/the-fallacy-of-the-short-sharp-war-optimism-bias-and-the-abuse-of-history.
18 Buehler, R., Griffin, D. and Peetz, J. (2010), 'The Planning Fallacy: Cognitive, Motivational and Social Origins', *Advances in Experimental Social Psychology*, 43, pp. 1–62, https://doi.org/10.1016/S0065-2601(10)43001-4.
19 Hall Blanco, A. R. (2021), 'The Sunk Cost Fallacy in the War on Terror', The American Institute for Economic Research, 3 September 2021, https://www.aier.org/article/the-sunk-cost-fallacy-in-the-war-on-terror.
20 Kahneman, D. and Tversky, A. (1979), 'Prospect Theory: An Analysis of Decisions under Risk', *Econometrica*, March 1979, 47(2), pp. 263–92, https://doi.org/10.2307/1914185.
21 Kahneman, D. (2011), *Thinking, Fast and Slow*, London: Penguin Books.
22 Gewertz, K. (2004), 'When the fog clears', The Harvard Gazette, 11 March 2004, https://news.harvard.edu/gazette/story/2004/03/when-the-fog-clears.
23 Plokhy, S. (2022), *Nuclear Folly: A New History of the Cuban Missile Crisis*, London: Penguin.

Training and drills among individuals involved in decision-making – including policymakers at various levels – can include behavioural exercises that both highlight the complexity of nuclear deterrence and challenge the belief that a nuclear confrontation can be contained. Training exercises are already common in both civilian and military institutions responsible for nuclear weapons strategy. However, additional exercises that seek to challenge the thinking behind overconfidence are rarely incorporated into these training regimens. Such exercises can help address several problems raised during expert consultations for this paper, examples of which are:

— Set-piece exercises, such as NATO's annual *Steadfast Noon* exercise, do not reliably replicate the uncertainty of real-life scenarios. Such exercises can therefore feel artificial, even if they fulfil other important training functions.

— Training simulations involving nuclear weapons may desensitize military personnel to their use, potentially leading to overconfidence in the ability to use a small number of tactical nuclear weapons without escalating the conflict into an all-out nuclear war.

— The way arms control and nuclear weapons history are taught in many institutions may increase desensitization. For instance, nuclear weapons history is frequently taught as a series of geopolitical decisions, treaties and strategic calculations. While these aspects are crucial to understanding, human consequences of nuclear testing and use are often overlooked.

The behavioural exercises discussed below could help stakeholders – ranging from policymakers to nuclear weapons operators – develop better rules of thumb for nuclear decision-making. Such basic rules are particularly relevant in moments of heightened tension or crisis, when there is little time to study crisis manuals. These exercises may also enable stakeholders to reconsider long-held assumptions in 'cooler', lower-stakes moments.

Premortems

'Premortems' involve groups imagining that a plan has failed – for example, a nuclear weapon being used accidentally. The group is then tasked with working backwards to identify potential causes of the failure. The aim of the exercise is to bring to the fore previously unconscious knowledge about weaknesses in the group's assumptions. Once weaknesses have been identified, steps can be taken to minimize the likelihood of these causes being triggered. Gary Klein has produced a practical guide to holding a project premortem. Although the guide is intended for a corporate audience, the set-up of the premortem is replicable in any team setting.[24]

Calibration

Fundamental to overconfidence is a miscalibration between expectations and outcomes. To correct this miscalibration, stakeholders can be asked to guess whether a series of statements are true or false and state their degree

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24 Klein, G. (2007), 'Performing a Project Premortem', Harvard Business Review, September 2007, https://hbr.org/2007/09/performing-a-project-premortem.

of confidence when doing so. If key stakeholders are shown to be overconfident, a 'recalibration' can occur whereby individuals adjust their confidence in a wide array of assumptions, including their assumptions surrounding nuclear risk, their confidence in the information they are receiving from their intelligence agencies, and their confidence in how an adversary will perceive their actions.

Box 1. Chatham House and The Behavioural Insights Team example exercise

Chatham House and BIT have developed an example calibration exercise specifically for nuclear decision-makers, which can be accessed here: https://bit.ly/nuclearcalibration.

Calibration exercises are often used for forecasting future events. However, this exercise uses a series of statements that are either true or false at the time of publication, to enable policymakers to gain an immediate understanding of how a calibration exercise may be designed.

Note: This exercise is merely illustrative. Calibration exercises should be tailored to the decision or decisions about to be taken by those following the exercise.

As an alternative, decision-making bodies could simply assume a degree of overconfidence and factor this into their final decision, such as by adding a set percentage to estimations of, for example, the risk of escalation or the resources needed to achieve a particular goal.

Simulations

One of the primary causes of overconfidence in the belief that a catastrophic event will not occur. Simulations of nuclear crisis – such as The Nuclear Biscuit project created by Sharon Weiner and Moritz Kuett[25] – allow decision-makers to 'experience' the crisis scenario, sensitizing them to their responsibilities and allowing them to practise thinking pathways in said crisis. This participation should go to the top level of political power, as leaders need to train on how to make high-stake decisions under pressure. Findings from interviews for this paper suggest that individuals are often surprised by their actions within the simulation, suggesting that policymakers may gain valuable insights into their decision-making under stress, thereby building awareness and resilience. Simulations are likely to be most effective when representatives of different states are brought together to play the same game, as occurred at the Nuclear Security Summit in the Netherlands in 2014,[26] and a series of exercises known as 'The Day After' carried out by the RAND Corporation in the early 1990s that were highly influential on government actors.[27]

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25 Princeton Science and Global Security (2021), 'The Nuclear Biscuit', https://sgs.princeton.edu/thenuclearbiscuit.
26 Escritt, T. (2014), 'Dutch PM gets world leaders to play nuclear wargame at summit', Reuters, 25 March 2014, https://www.reuters.com/article/uk-nuclear-security-wargame-idAFBREA2O1QB20140325.
27 Millot, M. D., Molander, R. C. and Wilson, P. A. (1993), *"The Day After…" Study: Nuclear Proliferation in the Post-Cold War World*, report, Santa Monica, CA: RAND Corporation, https://www.rand.org/pubs/monograph_reports/MR253.html.

Simulations and other 'wargames' and tabletop exercises, which have been described by high-level policymakers interviewed for this project as both 'chillingly realistic' and 'eye-opening', could also be made available to the next generation of decision-makers in universities, diplomatic academies and military academies to ensure they are trained in high-stakes decision-making as early and often as possible.

Red-teaming

'Red-teaming' is the practice of rigorously taking opposing views in order to test policy or to better understand others' positions. In such exercises, the 'red team' takes on the role of the challenger and asks questions, provides feedback or insights from the challenger's perspective. Red-teaming already takes places regularly in government settings. However, behavioural insights suggest a few adjustments to existing practices to make the practice more effective. Confirmation bias, group norms and strict hierarchies are all barriers to the vocalizing of opposing opinions on nuclear weapons policy. These barriers can be lowered if individuals are specifically nominated to adopt a contrarian position, and encouraged to point out the flaws in the group's thinking. A 'red team' can include individuals either internal or external to the main group. While internal appointees are likely to have greater subject-matter knowledge and rapport with the group, they are also likely to display greater loyalty to their team and thus be more reserved in their criticism. The UK Ministry of Defence has produced a comprehensive guide to incorporating red-teaming into institutional decision-making, with a particular focus on defence issues.[28] Certain appointees to the red team may also be tasked with voicing the perspective of the 'adversary', to prevent plans being made according to miscalibrated predictions of how an adversary will respond. It is important to ensure that the adversary is played by someone with significant expertise on the chosen country and its culture to avoid a one-dimensional caricature. As an additional step, more junior members of staff could be nominated to give their opinion before those in senior roles, and voting on decisions could be anonymized to prevent retaliation against non-conformists. Over the longer term, systematic and consistent red-teaming can help normalize the expression of alternative opinions, leading to lasting cultural change.

Reframing

Subtle and simple language alterations in various other policy domains change the way individuals respond to choices.[29] The same may be true of the nuclear weapons space, where the way decisions are framed – as well as their substance – could influence decision-making. The purpose of reframing exercises is not necessarily to indicate a preference for one choice over another. Rather, reframing seeks to point out what policymakers should be looking out for when choosing how to frame decisions to their colleagues and when being presented with decisions to make themselves. Table 1 presents several alternative framings relevant to the nuclear

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28 UK Ministry of Defence (2021), *Red Teaming Handbook, 3rd Edition,* London: UK Ministry of Defence, https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1027158/20210625-Red_Teaming_Handbook.pdf.
29 Londakova, K., Whincup, E., Meyer zu Bickwedde, E. and Gross, M. (2022), 'We need to talk about climate. But how?', blog post, The Behavioural Insights Team, 29 September 2022, https://www.bi.team/blogs/we-need-to-talk-about-climate-but-how.

decision-making. Policymakers should list the alternative framings that are key in their context, before deciding which best supports good decision-making in their specific case.

Table 1. Examples of alternative language framing in nuclear policy

Framing A	Framing B	Applications
Enemy	Adversary OR Competitor	If those presenting the decision anticipate decision-makers being too aggressive, use the term 'adversary'.
Tactical nuclear weapons; battlefield nuclear weapons; mini-nukes	Hiroshima/Nagasaki-sized weapon OR Nuclear weapons OR Referring to the explosive yield of the nuclear weapon	If policymakers are concerned that the dangers of tactical nuclear weapons are being obscured, they should refer to them simply as nuclear weapons or refer to their capability (e.g., as demonstrated in Hiroshima and Nagasaki).
Response	Escalation	Our expert interviewees commented that in crisis scenarios, there is often a scramble to 'own' the next step on the escalation ladder without decision-makers necessarily considering their actions as escalatory. Framers can therefore refer to a 'response' as an 'escalation'.
Backing down; retreat	De-escalation	If those presenting the decision fear that a course of action will be pursued because of fears over a loss of face, present the option as de-escalation that may be reciprocated by an adversary. If they are concerned that the decision-maker will lack resolve, present the choice as undermining the decision-maker's strength.

Historical case study workshops

Historical case study workshops may help nuclear policymakers appreciate the contingencies involved in nuclear near-misses and to identify potential weak spots that could lead to crisis in the future. The structure of these workshops could be as follows:

— Organizations select a 'nuclear near-miss' case study;[30]

— Knowing the outcome of the case study, decision-makers discuss the main junctures at which the situation could have gone wrong; and

— A collaborative list of relevant learnings is compiled from the workshop.

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30 Lewis, Williams, Pelopidas and Aghlani (2014), *Too Close for Comfort*.

Our expert interviewees pointed out that such workshops would be most useful if conducted across national divides, with military leaders and civilian decision-makers from different (including adversarial) perspectives taking learnings from the same set of case studies. As well as challenging overconfidence and acknowledging past mistakes, studying case studies may also lead to strengthening dialogue as a means of building understanding and empathy between nuclear powers. However, even unilateral lessons learned from previous (non-nuclear) crises seem to have effectively brought about greater restraint on the part of leaders during nuclear crises – during the Cuban missile crisis, for example, President Kennedy frequently referred to the fact that the European leaders 'sleepwalked' into the First World War because of their inability to communicate effectively, their overconfidence in predicting a short conflict and their inability to control events as effectively as assumed. These insights, taken from Kennedy's study of Barbara Tuchman's book *The Guns of August*, made him less confident in his ability to control events in Cuba.[31]

Although training exercises are resource-intensive, they should be considered an invaluable way of challenging overconfidence in the nuclear policy field by developing cultures of diverse, considered and well-calibrated decision-making.

Although training exercises are resource-intensive, they should be considered an invaluable way of challenging overconfidence in the nuclear policy field by developing cultures of diverse, considered and well-calibrated decision-making. Training alone, however, is not enough to challenge overconfidence. The norms of group decision-making must also change. One simple, immediate step is a commitment to slow decision-making if a situation allows, where at least one day or night is taken between an issue being discussed and a decision being made. This pause may allow time for the overconfidence of the group to dissipate.

Miscommunication

In times of crisis, heightened tensions and mistrust increase the risk of miscommunication between states, further exacerbating escalatory dynamics. In such contexts, communication between adversaries reduces, and any communication that does occur increases in ambiguity and hostility. The effectiveness of existing regular channels for communication during peacetime – such as treaty processes and confidence-building measures – often becomes limited. Not only can such diplomatic channels be too slow and bureaucratic

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31 Plokhy (2022), *Nuclear Folly*.

to effectively deal with an escalating crisis, but during times of heightened tensions, adversaries may feel disillusioned about international or bilateral processes that they perceive to operate against their strategic interests.

As George Bernard Shaw put it, 'the single biggest problem in communication is the illusion that it has taken place'.[32] Without effective and reliable avenues to verify potential misunderstandings, the history of nuclear near-misses has shown that it is easy for one side to assume that the other shares the same understanding of events. One of the most prominent examples of where a lack of effective communication channels led to rapid escalation is the Cuban missile crisis. Multiple crisis points throughout this period occurred, in part, due to a series of miscommunications between the Soviet Union and the US. Following the shooting-down of a US U-2 reconnaissance jet over Cuba, a mixture of muddled direct and indirect communications between Moscow and Washington led to a failure in understanding on each side. Records of government discussions from the time make clear that both Kennedy and Khrushchev were acutely aware of the risk of nuclear escalation once a certain point in the crisis had been reached.[33] Having come so close to nuclear war, the crisis ultimately resulted in the establishment of a 'hotline' between Moscow and Washington, ensuring a permanent and direct channel for communication in times of crisis.

In the Indo-Pacific, despite the regular low-level skirmishes between Indian and Pakistani armed forces and multiple instances of major crises in recent history, there remains limited direct communications between the two powers. The US has often played a third-party role in de-escalating incidents between India and Pakistan, such as in the 2002 standoff where rapid escalation between the two countries posed serious concern surrounding a nuclear war arising through a miscommunication.[34] A permanent communication channel between India and Pakistan was established in 2004 to reduce the threat of accidental nuclear war, following two days of talks on nuclear confidence-building measures.[35] However, the continued lack of trust between the two governments calls into question the effectiveness of this mechanism. Various proposals have called for improvements to the hotline agreement between India and Pakistan, whether by directly connecting their nuclear commands or by introducing other aspects of military-to-military communication.[36] The issue of miscommunication is likely to become even more complex as both India and Pakistan seek to introduce new technologies and capabilities, and political tensions continue to rise. The addition of sea-based nuclear weapons to India's nuclear arsenal and Pakistan's development of naval

32 Kenny, C. (2020), 'The single biggest problem in communication is the illusion that it has taken place', *The Irish Times*, 9 November 2020, https://www.irishtimes.com/culture/books/the-single-biggest-problem-in-communication-is-the-illusion-that-it-has-taken-place-1.4404586.
33 Plokhy (2022), *Nuclear Folly*.
34 Homan, Z. S., Dewey, K. F., Khurshid Mirza, E. and Set, S. (2022), *Communicating Deterrence: Drivers of Misperception in India & Pakistan,* London: King's College London Centre for Science and Security Studies, https://www.kcl.ac.uk/csss/assets/communicating-deterrence.pdf.
35 Lancaster, J. (2004), 'India, Pakistan to Set up Hotline', *Washington Post,* 21 June 2004, https://www.washingtonpost.com/archive/politics/2004/06/21/india-pakistan-to-set-up-hotline/37d9f17f-58ec-4696-96b3-9462a4ff2bea.
36 Hannah, H. (2019), 'A Hotline between National and Nuclear Command Authorities to Manage Tensions', South Asian Voices, 24 July 2019, https://southasianvoices.org/hotline-between-command-authorities-to-manage-tensions.

nuclear capabilities, for instance, pose additional challenges.[37] Given the low frequency of radio waves for communication when submarines are submerged, it may become more difficult to discern the true pattern of events should an incident occur at sea, which could easily lead to inadvertent escalation.

However, even where reliable channels for communication pre-exist a crisis, their success largely depends on both sides having an interest in a resolution.[38] In the context of deep mistrust and mutual hostilities, even where messages have been conveyed, adversaries may misunderstand one another due to entrenched beliefs and perceptions of the adversary, or because information was poorly communicated, not relayed to the right individual or deliberately misleading/ambiguous. Yet the existence of these emergency channels of communication does, at least in part, demonstrate a recognition of a mutual interest in preventing nuclear war.[39]

The cultural and linguistic differences between states are an important, but often overlooked, aspect of communication both during a crisis and outside of it. The most prominent case, and widely contested by language experts, is the US's interpretation of the Japanese word *mokusatsu* and whether its translation had a subsequent impact on the decision to drop atomic bombs on Hiroshima and Nagasaki.[40] At the close of the Second World War, the US submitted terms of surrender to Japan, contained within the Potsdam Declaration, to which Japanese prime minister Suzuki Kantaro responded in a press conference with the phrase *mokusatsu*. The translation has multiple meanings, including its common diplomatic use – translated to 'no comment' – as well as other meanings, such as the US interpretation – 'to treat with silent contempt'. While the direct impact of the *mokusatsu* incident on US decision-making is unclear, the case demonstrates the potentially catastrophic consequences of misinterpretation in cross-cultural communications at times when tensions are high. Without careful translation, language can be easily recontextualized due to linguistic and cultural differences. Cultural differences are reflected in language – words or concepts commonly understood in one language may not exist in another, or may carry different meanings, among other linguistic nuances, that can lead to confusion and mistrust in crisis communication and political discourse.

Outside of crisis, a failure between nations to properly understand one another exacerbates mistrust. Throughout the 2000s, bilateral nuclear diplomacy between China and the US was marred by poor communication and a failure to adequately ascertain one another's goals. The US, remaining unconvinced by the Chinese Ministry of Defence's nuclear deterrent posture and policy of No First Use (NFU), conducted widespread scrutiny of Chinese military

37 Ullah, S. (2020), 'Strategic Calculations Behind Pakistan's Pursuit of Sea-Based Nuclear Deterrence', South Asian Voices, 11 June 2020, https://southasianvoices.org/strategic-calculations-behind-pakistans-pursuit-of-sea-based-nuclear-deterrence.
38 Lewis, Williams, Pelopidas and Aghlani (2014), *Too Close for Comfort*.
39 Miller, S. E. (2021), 'Nuclear Hotlines: Origins, Evolution, Applications', *Journal for Peace and Nuclear Disarmament,* 4(sup1), pp. 176–91, https://doi.org/10.1080/25751654.2021.1903763.
40 See Kawai, K. (1950), '*Mokusatsu*, Japan's Response to the Potsdam Declaration', *Pacific Historical Review,* 19(4), November 1950, pp. 409–14, https://doi.org/10.2307/3635822; Rosenbluh, H. G. (1968), 'Mokusatsu: One Word, Two Lessons', *The National Security Agency Technical Journal,* Special Linguistics Issue 11, Fall 1968, XIII(4), https://www.nsa.gov/portals/75/documents/news-features/declassified-documents/tech-journals/mokusatsu.pdf.

literature. This led to unfortunate interpretations of certain documents, including assumptions that unreliable news stories were a representation of official Chinese positions.[41] Misreadings of Chinese nuclear weapons policy alongside other military doctrine, coupled with poor translation, impeded the ability of analysts to accurately interpret text, and led to assumptions that the Chinese Ministry of Defence had secretly altered its NFU commitment.[42]

Although machine-generated translations have improved significantly since then, considering their now widespread use, it is important to note that such technology may not always accurately capture contextual nuances. While the promise of technology to enhance translation is considerable, without due investment in personnel possessing fluent language skills and cultural understanding, overreliance on machine translation could introduce the risk of substantial misinterpretation.

While the promise of technology to enhance translation is considerable, overreliance on machine translation could introduce the risk of substantial misinterpretation.

In the 21st century, the risk of miscommunication is growing as the environment in which nuclear weapons exist continues to become more complex. The introduction of new technologies in the nuclear weapons system, cyber activities, disinformation campaigns, AI-generated 'deepfakes', the emergence of new nuclear-armed actors, the changing relationship between nuclear and conventional weapons, and a shifting global political landscape all exacerbate the dynamics of uncertainty.

Uncertainty surrounding the intention and capabilities of an adversary is compounded by policies of deliberate ambiguity and signalling in declaratory statements and nuclear postures. Today, the 'fog of war' is more complex than ever. The increasingly provocative rhetoric and use of veiled threats from public officials, such as that of Russian president Vladimir Putin in his 2023 speech declaring the suspension of Russian participation in the New START agreement with the US,[43] all heighten the risk of information overload in decision-making.

Tools and solutions

Miscommunication presents two levels of risk. At its most dangerous – and most likely –miscommunication occurs during a crisis, potentially leading to a catastrophic outcome. Outside of crises scenarios, miscommunication has the potential to worsen relations between potential adversaries, helping to precipitate

41 Oswald, R. (2011), 'U.S.-China Nuclear Talks Stymied by Distrust and Miscommunication', *The Atlantic*, 31 October 2011, https://www.theatlantic.com/international/archive/2011/10/us-china-nuclear-talks-stymied-by-distrust-and-miscommunication/247589.
42 Kulacki, G. (2020), 'Chickens Talking With Ducks: The U.S.-Chinese Nuclear Dialogue', Arms Control Today, 1 July 2020, https://www.armscontrol.org/act/2011-09/chickens-talking-ducks-us-chinese-nuclear-dialogue.
43 Faulconbridge, G. (2023), 'Russia's Putin issues new nuclear warning to West over Ukraine', Reuters, 22 February 2023, https://www.reuters.com/world/putin-update-russias-elite-ukraine-war-major-speech-2023-02-21.

future crises. Behavioural interventions can be applied to both circumstances, though are likely to be most usefully applied before crises unfold, or to build better communication mechanisms as crises 'cool down', as in the aftermath of the Cuban missile crisis. This is because, in times of extremely poor relations between states, even good faith attempts to communicate are less likely to be effective, as states are primed to assume the worst of an adversary's intentions. Overconfidence in beliefs about the adversary can also worsen miscommunication, since overconfidence can drive individuals to overlook, misinterpret and selectively hear information.[44]

A crucial kind of miscommunication results from a failure of one state to effectively signal its intentions to other states. This can occur during moments in which states outline their nuclear posture or discuss or demonstrate their nuclear weapons stance publicly. These include following nuclear weapons posture reviews, public statements by leaders or officials and military exercises. This could also include bilateral arms control treaties, such as New START, which put transparent limits on nuclear warhead numbers and categories of delivery vehicles. Potential solutions to this form of miscommunication include:

Defaults for better communication
In nuclear weapons policy, the closest thing to a default is a state's declaratory policy. A default describes a preselected choice (when to use a nuclear weapon) which will be made in a specific circumstance (e.g. following a first strike by an adversary). In the absence of significant alterations in declaratory policy, steps can still be implemented to reduce the chance of nuclear postures being misinterpreted – avoiding signalling intended to provoke is one such example.[45] More speculatively, NFU agreements could be agreed on a bilateral basis, for example with China (which itself already has a NFU policy). This could have positive spillover effects, potentially altering the norms of the international security environment. Unilateral pre-commitments could be made by states to change their posture if another state did (e.g. 'if country X declared a sole use policy, so would we'). Pre-commitments can be anchored to timely moments: for example, country X could pre-commit to engaging in constructive nuclear diplomacy if/when relations with country Y improve. As such, pre-commitments can serve as signals that country X is willing to work on improving its relationship with country Y. However, such policies necessitate a willingness to initiate a level of transparency surrounding nuclear weapons postures that is often at odds with the current policies of ambiguity that sit at the core of states' nuclear weapons doctrines.[46] As such, the success of declaratory policies like NFU agreements ultimately depends on the consistency of actions and practices of a nation, and must be accompanied by a pattern of transparency to be seen as credible.[47]

44 Kulacki (2020), 'Chickens Talking with Ducks'.
45 For instance, see Borger, J. (2022), 'Poland suggests hosting US nuclear weapons amid growing fears of Putin's threats', *Guardian*, 5 October 2022, https://www.theguardian.com/world/2022/oct/05/poland-us-nuclear-wars-russia-putin-ukraine.
46 See Schelling, T. C. (1959), *The Threat that Leaves Something to Chance,* Santa Monica, CA: RAND Corporation, https://www.rand.org/pubs/historical_documents/HDA1631-1.html.
47 Wheeler, N. J. (2009), 'Beyond Waltz's Nuclear World: More Trust May be Better'*, International Relations*, 23(3), pp. 428–45, https://doi.org/10.1177/0047117809340489.

Emulation teams

In addition to translating important documents such as posture reviews into key languages, taking steps to 'emulate' these documents can ensure their intended effect is adequately conveyed in those other languages. A notable example of this going wrong occurred in 2009, when then US secretary of state Hillary Clinton presented Russian foreign minister Sergei Lavrov with a red button stating 'overcharge' instead of 'reset' in Russian.[48] One way of testing that a text has been successfully 'emulated' would be to test it out on different target groups before publication, or to convene an internal 'red team' comprising experts with the necessary regional, cultural and linguistic expertise.

Developing ways of describing a common reality within a regional context

Expert interviewees stressed the importance of, for example, India and Pakistan developing their own vernacular for describing nuclear risks, as opposed to relying on a Western vocabulary that does not fit culturally or linguistically. Interviewees emphasized that, in certain cultures, metaphor, hyperbole and 'bluff' are used more commonly than in others. A first-step solution might be to convene a cross-border working group to create a glossary of nuclear terminology as it applies to a regional context. Such an initiative may have the additional benefit of building trust between parties.

Meeting in-person

Face-to-face meetings may contribute to increased empathy between officials and leaders from different countries, and may reduce the likelihood of the miscommunication that can result from inferences drawn from public statements. As Marcus Holmes argues, bilateral meetings such as the US–Russia Strategic Stability dialogues have been effective at building common understanding and avoiding false assumptions.[49] As Amy Woolf notes, even where arms-control measures were not codified into legally binding treaties, these dialogues still enabled Russia and the US to adopt transparency, communication and risk-reduction measures, thus contributing to strategic stability.[50]

As a crisis develops, behavioural insights can also be applied to de-escalate the situation:

Perspective rotations

These are an important way of developing strategic empathy or attempting to see a situation from the perspective of an adversary. They can also lead to better forecasting and therefore better countermeasures against the actions of hostile actors. Perspective rotations may reveal to participants that the language they are using to describe their intentions and actions might be interpreted more aggressively by adversaries than intended and, conversely, that the language and actions of their adversaries may have other motives beyond simply wanting

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48 Landler, M. (2009), 'Lost in Translation: A U.S. Gift to Russia', *New York Times*, 6 March 2009, https://www.nytimes.com/2009/03/07/world/europe/07diplo.html.
49 Holmes, M. (2018), *Face-to-Face Diplomacy: Social Neuroscience and International Relations,* Cambridge: Cambridge University Press.
50 Woolf, A. F. (2023), *The Past and Future of Bilateral Nuclear Arms Control,* Geneva: UNIDIR, 21 March 2023, https://unidir.org/publication/the-past-and-future-of-bilateral-nuclear-arms-control.

to escalate tensions. The rationale behind this is to attempt to move away from existing assumptions and entrenched thinking that leads to 'caricatures' of an adversary. This helps decision-makers think laterally, explore alternative explanations and avoid jumping to the conclusion that most easily comes to mind. Such practices are already regularly used in education spaces, such as in Model UN settings, where students emulate international diplomacy through debate on topics from the perspective of a national position different from their own.

Perspective rotations can be integrated into training regimens for decision-makers or brought out in response to a specific crisis. To hold a perspective rotation:

— A senior member of the organization (e.g. the foreign ministry) should start by choosing a scenario for the rotation.

— These scenarios might be a situation analogous to a current conflict, a real example from the past or a fictional scenario.

— Participants should represent the adversary in the chosen scenario.

— The leader of the perspective rotation can represent the perspective of their own country, collecting the responses of participants playing as the adversary.

— When the scenario has played out, the leader of the rotation should hold a feedback session in which participants reflect on whether new insights have been gained on the current conflict.

Internal communication
This also comes under strain during a crisis. Ensuring that there are standardized and easy ways of communicating that are developed, practised and refined during periods of non-crisis within and across government and military is crucial to ensuring that stakeholders can continue to communicate clearly and effectively through the crisis. This includes the dissemination of instructions by the central authority. These channels must leave space for contrary opinions and avoid framing options in particular ways (e.g. such that escalatory steps are preferred for reasons beyond their strategic merit). Opposing opinions can help target behavioural biases such as the 'affect bias' – where positive feelings towards a decision are substituted for rational arguments in its favour. A combination of the tools identified elsewhere in this paper, including **red-teaming** and **perspective rotations,** can also ensure better internal communication during crises.

Use mediators
When tensions begin to increase between states, miscommunication becomes more likely. Identifying dependable third parties that both states can trust as a messenger helps ensure that reliable communication channels between the conflicting states are maintained. For instance, the US's role in mediating diplomatic talks between India and Pakistan during periods of heightened tensions to prevent further nuclear escalation.

Redundancy planning

A safe assumption, especially during periods of crisis, is that miscommunication will occur, including between allies. It is therefore essential to develop mechanisms to detect when miscommunication has occurred, and to deploy alternative avenues of communication.

Two ways of detecting such miscommunication are:

— Following a meeting, each side writes an **appreciation detailing their understanding of what was decided during the meeting**. This may reveal that the two sides were talking at cross-purposes more than they had thought during the meeting. This exercise offers an opportunity for correction.

— **Using intermediaries**. If possible, identify a member of the team who is well positioned to 'translate' the intentions of each side for the other, due to a close working relationship or advanced cultural knowledge. In the Second World War, this role was played by John Dill, who was an effective go-between for George Marshall and Alan Brooke.[51]

Errors

There have been numerous incidents of errors throughout the history of nuclear weapons. For instance, cases of lost nuclear weapons from the Cold War, such as the 1966 incident in which four hydrogen bombs were released over the Spanish town of Palomares following the collision of an US bomber with a tanker plane. (One of those bombs was never located.)[52] More recent incidents, such as the collision of British and French submarines carrying nuclear weapons while on patrol in the Atlantic in 2009, have highlighted the fact that incidents involving nuclear weapons have not ceased over time, despite the introduction of more sophisticated systems and technologies, as well as the evolution of standards and policies.[53] While the full extent of past incidents is unclear, multiple publicly known accidents and errors could have resulted in accidental nuclear use, while there have been others in which inadvertent escalation leading to nuclear weapons use was a real possibility.

Nuclear weapons operate within a complex and multilayered system. As such, errors can arise for a range of different reasons, including technical malfunctions, procedural failures, and human and system failures. Rigorous policies and procedures for nuclear safety and security have developed over recent decades. However, the risk of human error through cognitive biases or performance can never be fully eliminated. In the words of Lieutenant General James Kowalski of the US Air Force (USAF), '… the greatest risk to my force is an accident. The greatest risk to my force is doing something stupid.'[54]

51 Brooke, A. F. and Danchev, A. (eds) (2022), *Alan Brooke War Diaries 1939-1945: Field Marshal Lord Alanbrooke,* London: Orion Publishing Group.
52 Moran, B. (2009), 'Lessons from the Palomares nuclear accident', Bulletin of the Atomic Scientists, 13 May 2009, https://thebulletin.org/2009/05/lessons-from-the-palomares-nuclear-accident.
53 Burns, J. F. (2009), 'French and British Submarines Collide', *New York Times,* 16 February 2009, https://www.nytimes.com/2009/02/17/world/europe/17submarine.html.
54 Air Force Association, National Defense Industrial Association and Reserve Officers Association (2013), 'Nuclear Deterrent, Prompt Strike, and Triad Perspectives: Speech, Lieutenant General James Kowalski, Commander, United States Air Force Global Strike Command, Capitol Hill Breakfast Forum, Washington, DC', 31 July 2013, https://secure.afa.org/HBS/transcripts/2013/073113ndiakowalski.pdf.

Yet the human element of nuclear safety and security has historically been a crucial factor in the prevention of escalation and accidental nuclear use. Thus far, multiple past cases of near nuclear use have been averted through good human judgement, often through individuals acting against protocol to avert nuclear catastrophe, such as in the 1983 Soviet Union nuclear false alarm incident.[55] In the context of a period of heightened tensions within the Cold War, Stanislav Petrov, the commander on duty in an early-warning satellite system control centre, interpreted an incoming US nuclear launch warning detected by satellite sensors as a false alarm. Petrov's good judgement – or as he described it, a 'funny feeling in his gut'[56] – may have prevented further escalation up the chain of command. This perhaps averted an unintentional nuclear exchange, demonstrating the crucial role of human judgement in crisis decision-making.

However, decision-making can also be negatively impacted as a result of individual human judgement and biases, which are shaped by a complex range of factors, including the background, existing beliefs, culture and religion of an individual, as well as organizational biases more generally.[57] One former senior official interviewed as part of this project highlighted that those responsible for handling nuclear weapons tend to come from a similar demographic background and therefore share similar beliefs and preconceptions. In crisis situations, a lack of contextual background and perspective to the work of personnel could result in a lack of situational awareness and the misinterpretation of events. Particularly in hierarchical models such as military settings, unquestioning obedience to standard operating procedures and protocols, as well as overconfidence in early-warning systems and other technologies, can inhibit the ability to exercise discretionary judgement in crisis situations, creating the potential for inadvertent escalation up the chain of command.[58]

Errors can also result from human performance-related factors in personnel carrying out routine duties related to the handling of nuclear weapons. The day-to-day, largely repetitive duties of personnel can lead to a lack of vigilance over safety and security protocols. In 2013, several misconduct cases were reported in the US, including that of an officer caught sleeping with a door open, violating safety and security procedures.[59] The monotonous duties of individuals handling nuclear weapons can result in sloppiness, as personnel find ways to overcome boredom. Spanning across the history of nuclear weapons, there have also been numerous reports of alcohol consumption and drug misuse among personnel, despite the development of rigorous screening processes.[60]

55 Unal, B., Cournoyer, J., Inverarity, C. and Afina, Y. (2022), *Uncertainty and complexity in nuclear decision-making*, Research Paper, London: Royal Institute of International Affairs, https://doi.org/10.55317/9781784135157.

56 Hoffman, D. (1999), 'I Had A Funny Feeling in My Gut', *Washington Post*, 10 February 1999, https://www.washingtonpost.com/wp-srv/inatl/longterm/coldwar/soviet10.htm.

57 Pfeifer, J. W. and Merlo, J. L. (2011), 'The Decisive Moment: The Science of Decision Making under Stress', *US Army Research,* 353, https://digitalcommons.unl.edu/usarmyresearch/353.

58 Unal, Cournoyer, Inverarity and Afina (2022), *Uncertainty and complexity in nuclear decision-making.*

59 Lewis, Williams, Pelopidas and Aghlani (2014), *Too Close for Comfort*.

60 Boffey, P. M. (1985), 'Report Warns on Personnel at Nuclear Sites', *New York Times,* 23 September 1985, https://www.nytimes.com/1985/09/23/us/report-warns-on-personnel-at-nuclear-sites. html; McCarthy, T. (2014), 'Dozens of US nuclear missile officers caught up in drug and cheating scandals', *Guardian,* 15 January 2014, https://www.theguardian.com/world/2014/jan/15/nuclear-missile-officers-suspended-drug-cheating-scandals.

Long periods of time in confined and often stressful conditions, such as in the case of lengthy nuclear submarine patrols, can lead to cases of depression and sleep deprivation among personnel that can impair decision-making.[61] The unusual shift hours of individuals handling nuclear weapons and related control systems can disrupt the natural functioning of human circadian rhythms, and has been correlated with greater incidences of accidents. Studies from the airline industry can help draw useful parallels for nuclear weapons operators, where most pilot accidents in aircraft simulators occur between the hours of 3 am and 5 am.[62]

Bigger errors often result from a series of low-level errors that become normalized over time, such as during routine tasks that are repetitive or overly cumbersome.

One interviewee for this paper indicated that bigger errors often result from a series of low-level errors that become normalized over time, such as during routine tasks that are repetitive or overly cumbersome. The combination of these low-level errors can result in a more serious error. Other errors can result from the misapplication of standard procedures or direct violations of safety and security codes. The organizational culture is an important determinant in shaping the conduct of individuals in the course of their duties. However, where procedures become too rigorous, such as through stringent inspections and overly punitive measures for mistakes, a culture of fear can develop. Personnel may then become unwilling to report errors for fear of repercussions on their career and reputation, which could lead to commanders covering up incidents. For instance, it was reported by the USAF in 2014 that 34 officers responsible for launching nuclear missiles had been suspended for cheating in proficiency tests.[63]

However, given the sensitivity of nuclear safety and security, the full scope of accidents across nuclear weapons states remains unknown. While information surrounding certain incidents has become publicly available, little is known about past accidents in most nuclear weapons states. This is due, in part, due to concerns that incidents might reveal weaknesses in a state's nuclear weapons capabilities, and to prevent unwanted external scrutiny surrounding the general safety of nuclear weapons. Where information is released, the seriousness of accidents is often downplayed by governments, or the full details are not made publicly available. The US has gone some way in acknowledging and addressing cases of nuclear weapons incidents with a degree of transparency. For instance,

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61 Forsyth, R. (2022), 'Extra-Long Trident Patrols Heightened Risks for Crew Wellbeing and Nuclear Safety', BASIC, 6 December 2022, https://basicint.org/extra-long-trident-patrols-heightened-risks-for-crew-wellbeing-and-nuclear-safety.
62 Solomon, F. and Marston R. Q. (eds) (1986), *The Medical Implications of Nuclear War*, Washington, DC: National Academies Press, https://www.ncbi.nlm.nih.gov/books/NBK219152.
63 Cooper, H. (2014), 'Cheating Accusations Among Officers Overseeing Nuclear Arms', *New York Times,* 15 January 2014, https://www.nytimes.com/2014/01/16/us/politics/air-force-suspends-34-at-nuclear-sites-over-test-cheating.html.

in 2007, the USAF introduced policy changes for the handling and delivery systems of nuclear weapons, following the reported mishandling of six nuclear warheads, including the labelling of nuclear weapons in storage hangars with placards.[64]

The secrecy with which nuclear weapons states treat past incidents inhibits both accountability and organizational learning. Organizations develop their own sets of shared biases that can impact the ability to learn from past incidents and the subsequent development of effective safety and security measures. The lack of transparency of most nuclear weapons states on past incidents poses challenges for assessing the extent to which incidents were met with effective policy and procedural change, as well as understanding wider political attitudes towards nuclear weapons safety policy. Failing to provide a full account of an incident risks the development of dangerous historical narratives of incidents that prevents learning. As such, greater transparency at the higher levels can lead to swifter policy changes in response to incidents, thereby mitigating risks arising from future incidents.

Tools and solutions

Many of the potential errors in the nuclear weapons field are a consequence of human behaviour going wrong. This is because the execution of nuclear weapons policy involves two extremes. On the one hand, weapons operators must remain vigilant despite an overwhelming majority never being called on to perform the services for which they have been trained. On the other, when they are called on to act, the time frame for action is small and the consequences unimaginably high. By targeting problematic behaviours, behavioural insights can contribute to reducing the possibility of errors in both situations.

In his work *The Design of Everyday Things*, Donald Norman identifies two different kinds of errors: mistakes and slips.[65] Whereas mistakes are the result of an agent having the incorrect goal, slips are the consequences of incorrect actions in the pursuit of correctly identified goals. Mistakes can be further subdivided into two main categories:

1. **Rule-based mistakes**, where the incorrect course of action for resolving a correctly identified issue is taken; and

2. **Knowledge-based mistakes**, where the agent misdiagnoses the problem due to erroneous or incomplete information.

Slips, which are more common still, can also be broken down into two categories:

1. **Action-based slips**, where the wrong action is performed despite the correct course of action being known; and

2. **Memory-based slips**, where memory fails, meaning an action is not done or its actions are not evaluated.

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64 Spiegel, P. (2008), 'U.S. nuclear focus has dimmed, studies find', *Los Angeles Times,* 13 February 2008, https://www.latimes.com/archives/la-xpm-2008-feb-13-na-b52s13-story.html; Pincus, W. (2008), 'Air Force Alters Rules for Handling of Nuclear Arms', *Washington Post,* 25 January 2008, https://www.washingtonpost.com/wp-dyn/content/article/2008/01/24/AR2008012402988_pf.html.
65 Norman, D. (2013), *The Design of Everyday Things: Revised and Expanded,* New York: Basic Books.

Table 2 presents examples of, and potential solutions to, the four kinds of mistakes and slips applicable to nuclear safety protocols.

Table 2. Recommendations by type of mistake in nuclear safety protocols

Type of mistake/slip	Examples from nuclear field	Inspiration for solutions
Rule-based mistake – i.e. **correct** diagnosis of the situation but **wrong choice** of action.	Although frequent inspections can uncover poor practice, they can lead to a culture wherein minor deviations from the inspection criteria are severely punished, instead of learned from, preventing the emergence of better practice. This was identified as a key weakness of the US nuclear forces in a 2014 report presented to the US Department of Defense.[66]	Following the 2014 report, the USAF has changed its guidance on the consequences of failed inspections.[67] Instead of punishment, poor practice can be used as an opportunity for correction and learning (see also BIT's project on 'teachable moments').[68]
Knowledge-based mistake – i.e. **incorrect** diagnosis of the situation	False alerts – such as in the 1983 Petrov incident – are one of the main ways in which an incorrect diagnosis of a crisis might occur. The 'cognitive overload' of a crisis is likely worsened by the 'cognitive underload' of unvaried and unstimulating work outside of crises.[69]	Receiver operating characteristic (ROC) curves may aid decision-making during crisis moments such as these. ROC curves may help nuclear weapons states calibrate their detection systems according to an optimal sensitivity – specificity trade-off to minimize the possibility of both false positives and false negatives. The historical record – which shows numerous false positives but no false negatives – suggests that detection systems should be calibrated for greater specificity. However, to ensure the credibility of the nuclear deterrent, detection systems should never be optimized solely for sensitivity. Rather, potential adversaries should be confident in the degree of certainty that would result in launching a strike.[70] Reduce incidence of 'cognitive underload' during normal moments by varying operators' tasks where possible or by introducing small tests during day-to-day work to keep operators alert. In the airport security industry, this has been attempted by randomly placing a mock explosive device in an item of luggage.[71] This will enable better preparation for crisis moments.

66 MacDonald, E. (2014), 'Independent Review of DOD's Nuclear Enterprise: Money, Maintenance, and Morale', Union of Concerned Scientists The Equation blog, 21 November 2014, https://blog.ucsusa.org/emacdonald/independent-review-of-dods-nuclear-enterprise-money-maintenance-and-morale.

67 Agnes, A. Y. (2016), 'Improving the Nuclear Reform Implementation for Success', *Air Force Institute of Technology*, *Theses and Dissertations*, 15 September 2016, 261, https://scholar.afit.edu/cgi/viewcontent.cgi?article=1260&context=etd.

68 The Behavioural Insights Team (undated), 'Strengthening the Metropolitan Police against cyber attacks', https://www.bi.team/case-studies/strengthening-the-metropolitan-police-against-cyber-attacks.

69 However, as Charles Perrow notes in *Normal Accidents,* there may also be hidden interactions within a system that are not visible to operators. In the case of the 3-Mile Island incident, for example, the relevant warning indicators on the control panel were obscured by a repair tag hanging over it. Perrow argues that these hidden interactions are endemic to tightly coupled, hazardous technological systems like nuclear power plants and nuclear weapon launch detection and early warning systems. See Perrow (1999), *Normal Accidents.* Similarly, while the introduction and improvement of technologies in detection and early warning systems may alleviate some risks, they also increase the complexity of these tightly-coupled systems.

70 Brown, C. D. and Davis, H. T. (2006), 'Receiver operating characteristics curves and related decision measures: A tutorial', *Chemometrics and Intelligent Laboratory Systems*, 80(1), pp. 24–38, https://doi.org/10.1016/j.chemolab.2005.05.004; Hajian-Tilaki, K., (2013), 'Receiver Operating Characteristic (ROC) Curve Analysis for Medical Diagnostic Test Evaluation', *Caspian Journal for Internal Medicine*, 4(2), pp. 627–35, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3755824.

71 Thornhill, J. (2023), '300 nuclear missiles are heading your way. You must respond. What now?', *Financial Times,* 19 January 2023, https://www.ft.com/content/06b22337-e862-43e5-8440-9c225e0c18d.

Action-based slips – i.e. **correct** diagnosis of the situation but action is **accidentally wrong**	In 2007, six nuclear missiles were unknowingly flown from Minot Air Force Base in North Dakota to Barksdale Air Force Base in Louisiana.[72]	In 2021, the US Navy instituted a new sleep policy that ensures sailors have protected sleep hours.[75] Steps to allow for more regular sleep and to reduce or eliminate activities that compete with protected sleep times could also be beneficial.
	Falling asleep on the job – in 2008, three intercontinental ballistic missile operators at Minot Air Force Base fell asleep for several hours while on duty.[73]	To improve staff retention and ensure that the most qualified and reliable individuals are attracted to nuclear operations roles, the USAF has attempted to improve incentives by providing better living and working conditions; better services for operators and their families; greater recognition; and better opportunities for career advancement.[76] Since more experienced and more qualified staff are less likely to make errors, staff retention is likely to reduce the number of errors. Furthermore, more reliable staff are less likely to have histories of alcohol or drug abuse.
	Drinking or taking drugs either in the workplace or before working has been found to be common among those responsible for safeguarding nuclear weapons in multiple countries.[74]	
Memory-based slips – i.e. **correct** diagnosis of the situation but action is **accidentally forgotten**	Forgetting to lock a door or perform necessary checks – for example, USAF officers at Barksdale have on multiple occasions been found leaving blast doors unlocked.[77]	In a hierarchy of hazard controls, elimination is always the preferred solution, as it avoids the need for behaviour change.[78] In the example given here, a potential solution would be to design and install doors that automatically lock.
		Where behavioural change is required, improved behaviour should be made as easy as possible. Most effective would be to create conditions where action X cannot take place without doing action Y – for example, a shift sign-off cannot be executed until a checklist of necessary actions has been submitted.

Encouraging the reporting of errors

Changes in policy can help encourage the reporting of errors at the operational level, thereby enabling better identification of the cause of an incident and the corrective actions that are needed to prevent its reoccurrence:

Clearly point to mechanisms for reporting concerns and develop them where they do not already exist (including by holding 'teachable moment' workshops as outlined earlier in this paper).

Remind personnel that it is not too late to report concerning behaviour (substance abuse, harassment) at timely moments, e.g. following leave or after a change of shift pattern. Communications could emphasize the necessity of everyone playing their part. Messages such as: 'Have you seen something on base that didn't look right? It's never too late to come forward. We're counting on you.'

72 Losey, S. (2019), 'You can call 2007 nuke mishandling an embarrassment, but don't call it the 'Minot incident'', *Air Force Times,* 25 June 2019, https://www.airforcetimes.com/news/your-air-force/2019/06/25/you-can-call-2007-nuke-mishandling-an-embarrassment-but-dont-call-it-the-minot-incident.
73 Pilkington, E. (2008), 'US missile alert crew falls asleep on the job', *Guardian,* 25 July 2008, https://www.theguardian.com/world/2008/jul/25/usa.
74 Wootson, C. R. (2017), 'Nuclear sub sailors fired after 'absolutely disgraceful' parties with a prostitute and cocaine', *Washington Post,* 28 October 2017, https://www.washingtonpost.com/news/worldviews/wp/2017/10/28/nuclear-sub-sailors-fired-after-absolutely-disgraceful-parties-with-a-prostitute-and-cocaine.
75 Fuentes, G. (2021), 'Latest Surface Navy Sleep Policy Aims for Better-Rested, More Alert, Healthier Crews', *USNI News,* 28 January 2021, https://news.usni.org/2021/01/28/latest-surface-navy-sleep-policy-aims-for-better-rested-more-alert-healthier-crews.
76 MacDonald (2014), 'Independent Review of DOD's Nuclear Enterprise'.
77 Associated Press via *Guardian*, 'US air force officers in charge of nuclear missiles left blast door open', 23 October 2013, https://www.theguardian.com/world/2013/oct/23/us-air-force-nuclear-missiles-blast-door.
78 Tap Into Safety (undated), 'Workplace Hazards and the Hierarchy of Controls', https://tapintosafety.com.au/workplace-hazards-and-the-hierarchy-of-controls.

Officers can also create a culture conducive to reporting problematic behaviour by outlining clearly how those individuals who report such behaviour will be protected.

Public and political salience

Public salience – i.e. the level of awareness and concern among the general public regarding a particular issue – can have a significant impact on nuclear weapons policy. It can influence the degree of public pressure exerted on policymakers, the level of support for disarmament initiatives and the willingness of states to engage in arms control negotiations. In the context of nuclear weapons policy, public salience can vary greatly depending on factors such as the perceived threat of nuclear war, the credibility of nuclear deterrence and the perceived benefits and costs of maintaining a nuclear weapons capability. Political salience, meanwhile, refers to the degree to which an issue is seen as important by policymakers and political elites. In the context of nuclear weapons policy, political salience can be influenced by a range of factors, including geopolitical tensions, domestic political considerations and the perceived impact of nuclear weapons on national security, as well as the level of public salience. Political salience can determine the prioritization of resources, the allocation of funds for nuclear modernization, and the level of commitment to disarmament and non-proliferation efforts.

> **In the context of nuclear weapons policy, public salience can vary greatly depending on factors such as the perceived threat of nuclear war, the credibility of nuclear deterrence and the perceived benefits and costs of maintaining a nuclear weapons capability.**

The interaction between public and political salience is complex and dynamic. Public opinion can shape political salience by creating pressure for policymakers to respond to popular concerns. Conversely, political salience can influence public opinion by framing the narrative on nuclear weapons policy and shaping the information and arguments presented to the public. As one interviewee noted, in the case of India and Pakistan, the framing of nuclear weapons by governments in public discourse as a necessary component of each state's national security, can result in a so-called 'commitment trap' where government officials lock themselves into certain postures and behaviours that have been communicated to the public.[79] Political framing can also impact on public beliefs. For example, there is evidence that the narrative developed by US secretary of war Henry Stimson following

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79 Homan, Dewey, Khurshid Mirza and Set (2022), *Communicating Deterrence.*

the bombing of Hiroshima and Nagasaki in 1945 – that the decision to use to the atomic bombs was one carefully weighed against a land invasion – continues to hold sway today, despite numerous revisionist accounts.[80]

While public engagement is a cornerstone of democratic decision-making processes, it is important to recognize that public sentiment can be influenced by various factors including media coverage, external global affairs, as well as political narratives. As the Russian invasion of Ukraine shows, a heightened public salience can sometimes lead to a more favourable view of nuclear weapons capability,[81] whereas at other times, it has led to greater demand for arms control and non-proliferation.

The interaction between public and political salience is rooted in a complex range of factors, such as the cultural and historical background, prevailing ideologies, economic and even religious motivations. The influence of the Russian Orthodox Church in Russia's nuclear weapons policy can be seen through the history of its instrumentalization for national security purposes.[82] For example, the Church gives legitimacy to Russian military investments by holding ceremonies to bless new equipment. Moreover, Russian Orthodox clergymen have played a role in the development of Russia's nuclear policy since the Soviet collapse in 1991.[83] The influence of religion on nuclear weapons policy has also been observed in the US, as exemplified by an interviewee's account of a senator changing his stance on ratifying the Comprehensive Test Ban Treaty based on advice from his church minister. Similarly, various religious organizations (including, among others, the Mennonites, the Quakers and the Southern Baptist Church) have historically played a significant role in US politics in advocating for arms control.[84] The interplay between elite political and public narratives on nuclear weapons is therefore complex. However, greater civic participation on nuclear weapons policy issues may lead to additional solutions on how nuclear weapons risks might be mitigated.

80 Pelopidas, B. and Egeland, K. (2020), 'What Europeans believe about Hiroshima and Nagasaki – and why it matters', Bulletin of Atomic Scientists, 3 August 2020, https://thebulletin.org/2020/08/what-europeans-believe-about-hiroshima-and-nagasaki-and-why-it-matters.
81 Onderco, M., Smetana, M. and Etienne, T. W. (2023), 'Hawks in the making? European public views on nuclear weapons post-Ukraine', *Global Policy*, 14(2), pp. 305–17, https://doi.org/10.1111/1758-5899.13179.
82 Adamsky, D. (2022), 'Russia's Menacing Mix of Religion and Nuclear Weapons', *Foreign Affairs*, 5 March 2022, https://www.foreignaffairs.com/articles/russian-federation/2022-03-05/russias-menacing-mix-religion-and-nuclear-weapons.
83 Adamsky, D. (2019), *Russian Nuclear Orthodoxy: Religion, Politics, and Strategy,* Stanford, CA: Stanford University Press.
84 Briggs, K. A. (1979), 'Evangelicals adding a New Voice to Church Drive for Arms Control', *New York Times,* 18 February 1979, https://www.nytimes.com/1979/02/18/archives/evangelicals-adding-a-new-voice-to-church-drive-for-arms-control-a.html.

Tools and solutions

The 'feedback loop' between public and political influence plays a critical factor in shaping nuclear weapons policy. As both public and politicians can shape each other's views, the approaches described in this section aim to shift the views of both groups.

Films and media

Through its exceptional reach and effective storytelling, mass media such as television, radio and the internet can be used to influence and mobilize people on nuclear weapons issues.

In the late 1950s and early 1960s, a campaign to educate citizens about potential health risks associated with above-ground nuclear testing played a major role in convincing President Kennedy to sign the Partial Test Ban Treaty. The campaign was based on the findings from the Baby Tooth Survey that collected over 320,000 milk teeth from children in St Louis, Missouri and found dangerous levels of strontium-90 – a cancer-causing isotope linked to over 400 atomic tests in the US.[85] In 1964, the Stanley Kubrick comedy film Dr. Strangelove highlighted the risks of military control over nuclear weapons, helping to promote the implementation of coded switches to prevent unauthorized use of nuclear weapons.

In recent decades, the issue of nuclear weapons has receded from both the public consciousness and political discourse. The use of storytelling through mass media has the potential to bring the issue back to the forefront of public consciousness, which in turn could influence political discourse and decision-making. Resources explaining the risks of nuclear weapons can be disseminated widely for free via internet media platforms such as YouTube. An example of this is the film 'What if we nuke a city?', produced by the popular channel 'Kurzgesagt – In a nutshell' in collaboration with the International Red Cross, which has been viewed more than 26 million times.[86]

Increased transparency of previously classified information

Information related to conflict and the military has traditionally been hidden from public view.

In recent years, however, military and intelligence agencies have taken a different approach and started to share information with the public that previously might have remained secret, with the aim of shifting the narratives around a conflict. This is best exemplified by the UK and US 'prebunking' of Russian disinformation, mainly via sharing declassified intelligence findings with media outlets, conducting public intelligence briefings on the war and by sharing classified intelligence between allies. This broader dissemination of information helps to build a common understanding of Russia's military plans and any disinformation campaigns

85 Gerl, E. (2014), 'Scientist-citizen advocacy in the atomic age: A case study of the Baby Tooth Survey, 1958-1963', *PRism,* 11(1), https://www.prismjournal.org/uploads/1/2/5/6/125661607/v11-no1-a1.pdf.
86 Kurzgesagt – In a Nutshell via YouTube (2019), 'What if We Nuke a City?', video, 13 October 2019, https://www.youtube.com/watch?v=5iPH-br_eJQ.

it might be planning – for example, by detailing Russian plans for 'false-flag' attacks and unfounded allegations against Ukraine regarding its supposed use of chemical weapons ahead of their dissemination by Russian channels.[87,88]

This approach has challenged assumptions about what does and does not need to be secret, and the role that increased transparency can have in shifting public opinions. Discussion about nuclear weapons policy is often shrouded in secrecy and ambiguity. The stated nuclear policy of many countries with nuclear weapons is purposely ambiguous – for example, keeping undefined what existential threats mean in relation to situations in which nuclear weapons can be used. While ambiguity plays an important role in maintaining deterrence postures, it is difficult to get the level right. Too much ambiguity not only risks an increased chance of misunderstanding between nuclear adversaries, but prevents engagement among the wider population and political actors. Starting a public discussion about these issues could be a helpful step to increasing engagement.

Visceral experiences and real-world impact

Since the end of the Cold War, the issue of nuclear weapons has become rather abstract and distant for many people in Europe and the US. For much of the public and many politicians, nuclear risk is far removed from their everyday reality and appreciation of the grave consequences of a potential escalation is low. To combat the risk of complacency, policymakers, educators and advocates alike need to find ways to make nuclear weapons more visceral and less abstract, and to create experiences that will shift attitudes and salience.

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First-hand experience of the effects that nuclear detonations have had on their environment could be a powerful way to achieve this. A visit to a former test site or to the Hiroshima and Nagasaki memorials, for example, is likely to change a person's understanding of, and attitude to, nuclear weapons. While these experiences are not scalable, other more accessible ways to create a similar effect do exist.

One such method is through use of virtual reality (VR). An example of a nuclear VR experience is the Nuclear Biscuit,[89] which immerses participants in a nuclear-crisis scenario to analyse how different options and framings affect decision-making

87 Behavioural Insights Team (2022), 'What works in disinformation wars?', 24 March 2022, https://www.bi.team/blogs/what-works-in-disinformation-wars.
88 Herszenhorn, D. M. (2022), 'Ukraine and West see false flags flying as pro-Russian separatists urge for civilian evacuation', Politico, 18 February 2022, https://www.politico.eu/article/ukraine-west-false-flags-pro-russia-separatist-urge-civilian-evacuation.
89 Princeton Science and Global Security (2021), 'The Nuclear Biscuit'.

in these high-stress situations. Another way without having to rely on VR is by using an online tool like Nukemap, which shows the effects of a nuclear detonation in any city or town of the user's choice, and can help bring to life the devastating impact of nuclear weapons on a relatable scale.[90]

Public engagement via a visceral experience could increase interest in nuclear weapons issues and create public support for the ratification of some outstanding nuclear treaties, such as the Comprehensive Nuclear-Test-Ban Treaty, if connected to the right call to action. Experiences that make the concept of nuclear weapons less abstract can help ensure that both policymakers and the public are engaged and informed on nuclear risk.

Conclusion

The goal of this project has been to explore the concept of behavioural insights as applied to nuclear decision-making, and to point out areas in which behavioural insights could improve the process by which nuclear decisions are made. The areas covered in this paper do not aim to be exhaustive; other areas that seemed promising for behavioural interventions were initially identified, but ultimately fell outside the scope of this paper.

Behavioural insights can help to improve the efficiency of states' security infrastructure and diplomatic processes. As the international security environment continues to deteriorate, it will likely take some time for such improvements to be made and take effect. Over both the medium and long term, however, behavioural insights could play an increasingly significant role in formulating policy recommendations for nuclear policy.

In particular, former officials consulted as part of the project mentioned the difficulties in changing institutional culture, which is an important part of ensuring that practices can be updated and improvements stick. Examining institutional and strategic culture in greater depth and identifying best practice for having a positive culture of lifelong learning and development are areas where behavioural insights could help facilitate lasting change. The importance of developing specific training for leaders to give them a better understanding of how they might react in a crisis is another important lesson. Making good decisions under stressful conditions is difficult. Giving leaders the space to develop crisis decision-making practice that allows them to strengthen their resilience and calibrate overconfidence where necessary would greatly increase government resilience overall.

A significant nuclear policy challenge is expected to arise in the next decade regarding how to negotiate new arms control agreements after many treaties have expired or have been suspended. Behavioural insights can play a significant role in the process of defining how to structure the negotiations for new types of arms control – including 'behavioural' arms control, which aims to encourage restraint and predictability among states. Behavioural insights can also help develop incentive structures for compliance. While it might be easier to incorporate

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90 Nuclear Secrecy (2012), 'Nukemap', https://nuclearsecrecy.com/nukemap.

best practice in newly negotiated treaties, there might also be a role for behavioural insights in reviewing and updating existing diplomatic processes to enable relationship-building between states and improve the negotiation experience. A working group of States Parties to the Non-Proliferation Treaty (NPT) convened to discuss the question of NPT reform ahead of the 2022 Preparatory Committee meeting. This is one example where behavioural insights could help with the analysis and recommendation of how to improve all states parties' negotiation experience. States' discussions highlighted the potential for negotiation processes to be updated to enable better interaction between States Parties and allow progress on agreed actions to be tracked and carried forward more easily. Easing some of these sources of tension within the NPT would help strengthen the treaty and thereby also strengthen non-proliferation as a norm.

Finally, behavioural insights could help to develop comprehensive models of ally and competitor behaviour, as well as ensuring these models are fed into all aspects of policy testing. As discussed in earlier sections of this paper, examples of good practice already exist in some governments and for certain policy areas – particularly with regard to red-teaming or emulation. However, experts consulted for this project noted the risks of poor-quality red-teaming. Caricatures of a potential adversary are easy to conjure and difficult to dispel, as they reinforce inaccurate narratives already present in public discourse. It is therefore important for red teams to contain regional, cultural and linguistic experts to provide useful insights into an adversary's domestic environment and strategic culture.

Behavioural insights have the potential to help the nuclear policy field to update processes and practices and innovate thinking for the challenges ahead. Heightened international tensions, nuclear modernization processes and interlocking domestic and international crises make this a difficult time to reduce nuclear risks. However, given the potentially catastrophic impact of nuclear weapons, the work of improving decision-making remains crucial.

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Independent thinking since 1920