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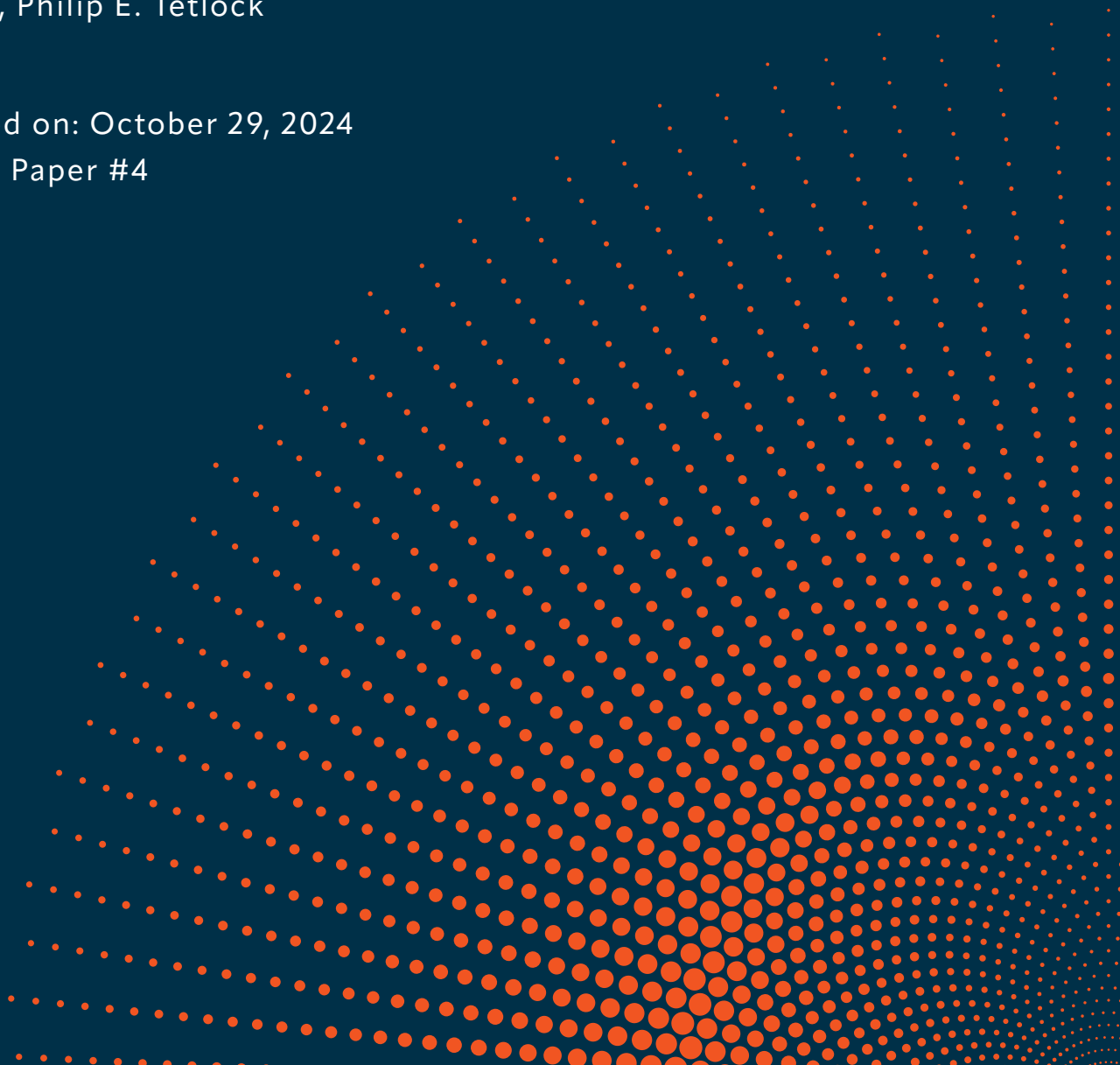
First released on: October 29, 2024
FRI Working Paper #4



Can Humanity Achieve a Century of Nuclear Peace?

Expert Forecasts of Nuclear Risk[1]

Authors: Bridget Williams,* Ezra Karger,*† Andreas Persbo,‡ Kseniia Pirnavskaia,‡ Karim Kamel,‡ Victoria Schmidt,* Otto Kuusela,* Zach Jacobs,* Philip E. Tetlock*§

Abstract

While the world has avoided large-scale nuclear war, questions remain about the role of chance versus policy choices in preventing such events. This study systematically assesses expert beliefs about the probability of a nuclear catastrophe by 2045, the centenary of the bombings of Hiroshima and Nagasaki. We define a nuclear catastrophe as an event where nuclear weapons cause the death of at least 10 million people. Through a combination of expert interviews and surveys, 110 domain experts and 41 expert forecasters ("superforecasters") predicted the likelihood of nuclear conflict, explained the mechanisms underlying their predictions, and forecasted the impact of specific tractable policies on the likelihood of nuclear catastrophe. Experts assigned a median 5% probability of a nuclear catastrophe by 2045, while superforecasters put the probability at 1%. Factors contributing to higher risk estimates included ongoing geopolitical tensions, the proliferation of nuclear weapons, and technological vulnerabilities. Lower risk estimates highlighted the continued effectiveness of nuclear deterrence. Although Russia and NATO was the adversarial domain thought most likely to cause a nuclear catastrophe, experts believe that risks are dispersed roughly uniformly across regional conflict theaters (Russia and NATO, China and the USA, the Korean Peninsula, India and Pakistan, and Israel and Iran). Participants believe that the implementation of a bundle of six tractable policies, including the establishment of a crisis communications network and the implementation of failsafe reviews, would together halve the risk of a nuclear catastrophe.

[1] This research would not have been possible without the generous support of Open Philanthropy. We thank the following people, who kindly served as expert interviewees: James Acton, Catherine Dill, Robert Einhorn, Peter Hayes, Feroz Khan, Frank O'Donnell, David Santoro, Manpreet Sethi, Sir Graham Stacey, Dmitry Stefanovich, Tatsujiro Suzuki, Jon Wolfsthal, and Tong Zhao. Their expertise helped to inform the direction of the project, but we note that the content of the project and this report don't necessarily reflect their views. We also thank Peter Scoblic for helpful feedback on survey questions. We greatly appreciate the assistance of Josh Rosenberg, Kayla Gamin, Sam Glover, Harrison Durland, Nikitas Angeletos Chrysaitis, Catherine Wu, Amory Bennett, Kaitlyn Coffee, Coralie Consigny, Rhiannon Britt, and Rebecca Ceppas de Castro throughout the project. Lastly, we extend our gratitude to our research participants for their invaluable contributions.

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Executive Summary

This study is the largest systematic survey of subject matter experts on the risk posed by nuclear weapons. In addition to experts, we surveyed forecasters with a strong track record of accuracy ("superforecasters"). The study summarizes responses on two complementary surveys taken a month apart: the first survey focused on risk pathways and the second on policy responses.

Participants

A total of 151 participants (110 experts and 41 superforecasters) completed the full first survey, and 148 participants completed both surveys (109 experts and 39 superforecasters). Most respondents engaged deeply with the questions. The median expert or superforecaster participant reported spending nine hours completing the two surveys and wrote around 4,200 words to explain their forecasts.

Key results

Forecasts of nuclear catastrophe by 2045

We asked participants to estimate the probability that, before 2045, one or more incidents involving nuclear weapons will cause the death of at least 10 million people. The median expert forecast was 5% and the median superforecaster response was 1%. The median forecast from a sample of the US public was 10% (see Figure 1). Respondents thought that a nuclear conflict between Russia and NATO was the adversarial domain most likely to be the cause of a nuclear catastrophe of this scale; however risk was dispersed relatively evenly among all adversarial domains we asked about, which also included China and the USA, the Korean Peninsula, India and Pakistan, and Israel and Iran.

Participants who were more concerned about nuclear risk often mentioned ongoing military conflicts between nuclear powers, the proliferation of nuclear weapons, the development of new military technologies, and the weakening of international arms control agreements. Participants less concerned about nuclear risk emphasized the long-standing effectiveness of deterrence, improvements in safety mechanisms, and the assumption that most nuclear states will act rationally.

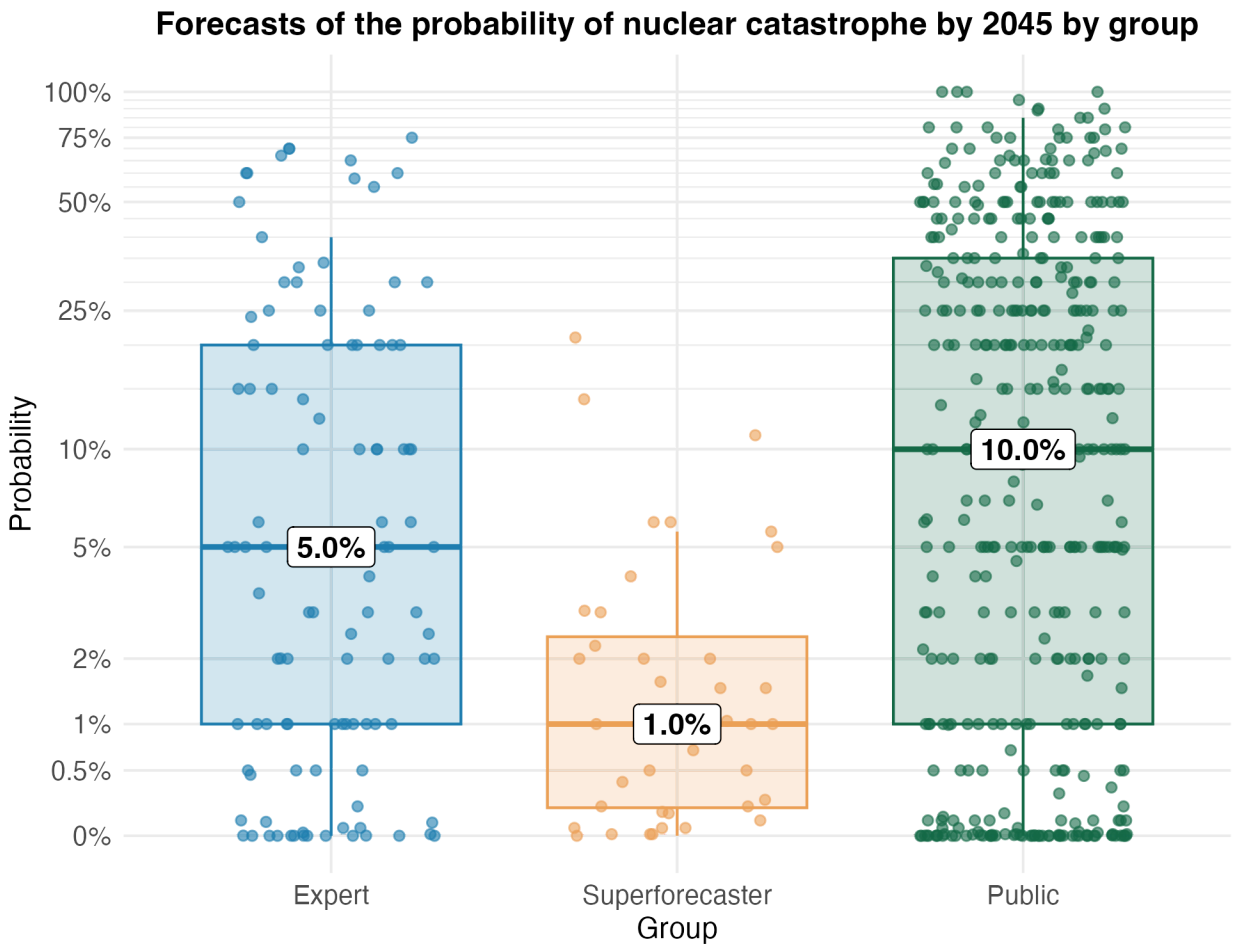

Figure 1: *Distribution of forecasts of the probability of nuclear catastrophe by 2045. We jitter the data points horizontally to allow for better visualization of the distribution of forecasts. Horizontal variation within each group serves no other empirical purpose. The y-axis uses a logarithmic scale to informatively show variation in forecasts in the 0–10% range.*

Factors influencing risk

Participants saw conflict between adversarial countries and new actors acquiring nuclear weapons as the major drivers of nuclear risk. We discuss a large set of events in this study, but to summarize three key events:

1. The median participant in this study reported that violent conflict between Russia and NATO would triple the risk of a nuclear catastrophe. Both experts and superforecasters reported a low probability of this event occurring: median forecasts of 5% and 1.8%, respectively;
2. Participants were more concerned about the likelihood of a Chinese invasion of Taiwan, with the median expert estimating a 25% chance of this occurring by 2030. The median expert reported that this event would roughly double their forecast of the risk of nuclear catastrophe;
3. The median expert also put a 25% chance of Iran acquiring nuclear weapons by 2030. Should this event occur, their forecast of the risk of catastrophe would increase by 50%.

Many of the events we asked about did not influence the median respondent's forecast of the risk of nuclear catastrophe. These events include: summits between adversarial countries, a nuclear weapons test by North Korea, ballistic missile submarines becoming more detectable, and an accidental non-test detonation of a nuclear weapon.

Effects of policies

We asked participants about their beliefs on the effectiveness of several policy options aimed at reducing the risk of a nuclear catastrophe. The distribution of relative risk scores for the six policies we included are shown in Figure 2. We also asked participants to rank the policies by how much they would like to see each policy implemented and how much they would support funding aimed at implementing the policies.

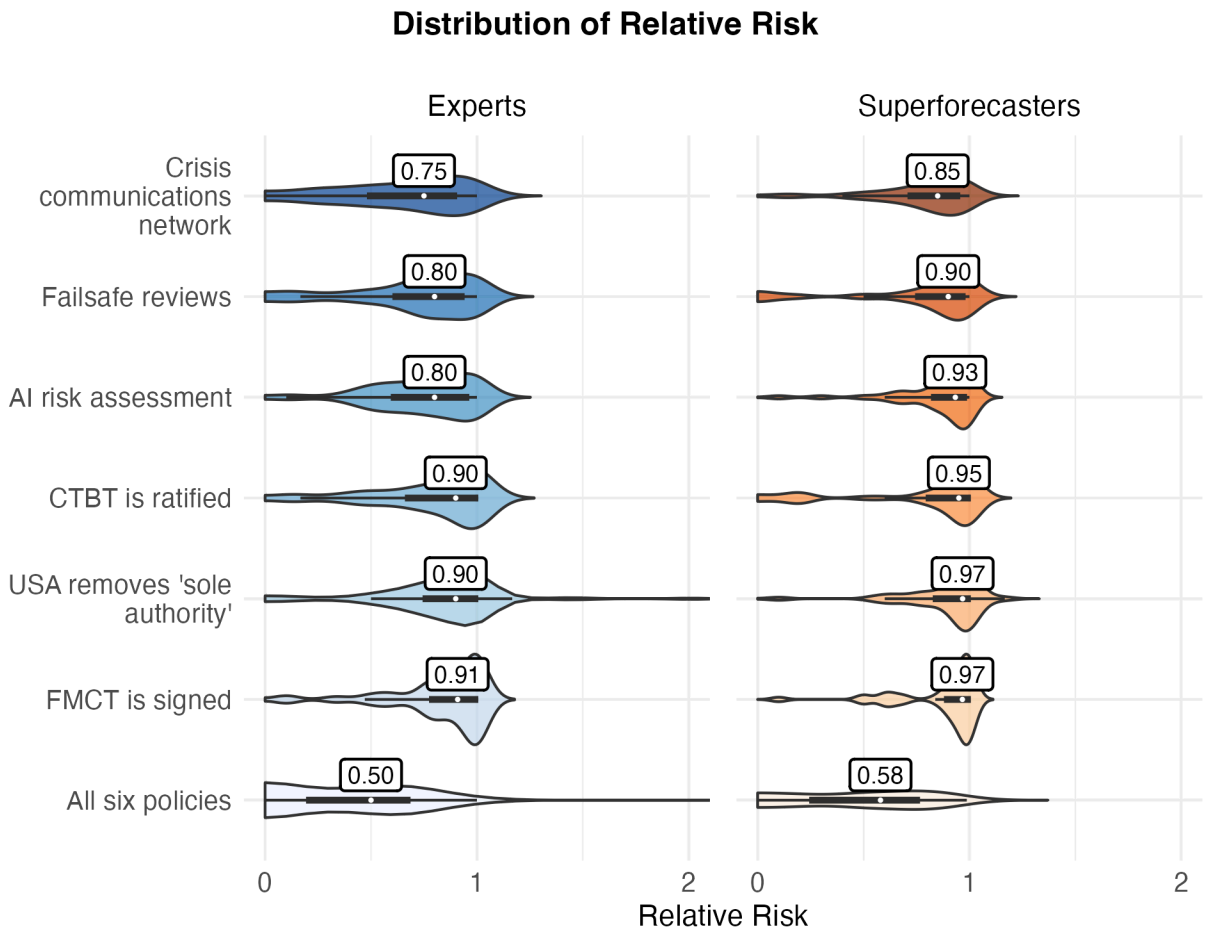

Figure 2: *Violin plots showing distribution of relative risk associated with each policy, and all six of these policies implemented together. The relative risk is the relative change in probability of nuclear catastrophe conditional on policy implementation. The group median is shown in text. The thicker bar within each violin shows the interquartile range (25th to 75th percentile forecasts), and the thin line shows the range of forecasts minus outliers.*[2]

[2] We define an outlier as any observation that falls below (Q1 - 1.5×IQR) or above (Q3 + 1.5×IQR), where Q1 and Q3 are the first and third quartiles and IQR is the interquartile range.

Two policies emerged as clear favorites: a crisis communications network[3] and nuclear-armed states implementing failsafe reviews.[4] The median expert thought that a crisis communications network would reduce the risk of a nuclear catastrophe by 25%, and failsafe reviews would reduce it by 20%. The superforecasters were less optimistic about the effects of the policies, with median relative risk of 15% and 10%, respectively. We also asked experts to say how their forecast of nuclear catastrophe by 2045 would change if all six policies we described were implemented. The median expert thought that the combined bundle of policies would halve the risk of a nuclear catastrophe and the median superforecaster thought it would reduce risk by 42%.

Probability of policy implementation

We asked participants to forecast the probability that each policy would be implemented (on a time frame consistent with a decision to implement the policy within the next three years). The median expert forecasted a 15% probability of implementation for the crisis communications network and a 15% probability of implementation for the failsafe reviews policy. Superforecasters estimated probabilities of 10% and 7%, respectively. Both groups thought that funding could improve the probability of policy implementation. Conditional on $500 million of funding being put towards the goal of having the policy implemented, the median expert forecasted a 25% chance that a crisis communications network would be established and a 30% chance of the failsafe reviews policy being implemented. The median superforecaster's forecast rose to 18% and 10%, respectively.

Limitations and next steps

While this study is the largest and most comprehensive survey of nuclear experts' beliefs about nuclear risk, there are some important limitations that we hope to address in follow-up work. First, most participants were based either in the USA or Western Europe. The number of expert participants from South Asia was similar to the number from the USA, but there were very few participants from East Asia, Eastern Europe, or the Middle East. Although this was the largest survey of its kind, the sample size was still relatively small, limiting the statistical inferences we can make from the results. The lists of policies we included may not have represented the full range of viewpoints on reducing nuclear weapons risk.

Despite these limitations, this study provides important insight into views on the risk of nuclear war. It clarifies experts' views on how the world could best mitigate those risks and maintain nuclear peace until and beyond the centennial anniversary of the first and so far only use of nuclear weapons in warfare. We believe there is a role for quantitative forecasts to build upon this work, improving our understanding of beliefs about nuclear weapons use and how the associated risks change over time.

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[3] This policy would see all nuclear-armed states participating in a secure (to damage to physical infrastructure and cyberattacks) communications network that allowed bilateral and multilateral communication between country leaders. (See Appendix 4 for more detail.)

[4] This policy would see all nuclear-armed states establish a review mechanism based on national defense guidelines to identify and develop plans to mitigate risks of inadvertent or accidental nuclear use. (See Appendix 4 for more detail.)

1. Background

Since 1945, the world has lived under the threat of nuclear weapons. So far, we have managed to avoid the disaster that would be nuclear war. Have we been lucky? Or was the probability of nuclear war always low? How confident should we be that humanity will make it to the hundred-year anniversary of the bombings of Hiroshima and Nagasaki without any further nuclear catastrophes?

These questions are difficult to answer. However, understanding views on the magnitude and nature of this risk can inform decisions about how to best prioritize resources to improve humanity's prospects.

The goal of this study was to understand current views about the potential causes of a nuclear catastrophe. We systematically collected the views of subject matter experts, highly accurate forecasters ("superforecasters"),[5] and members of the public on the threat of nuclear weapons. Specifically, we asked participants to forecast the probability that we will survive a century without another nuclear catastrophe, and the effects of events and policies that may alter this outlook. The result is the largest survey ever conducted of policy experts' views on the magnitude of risks posed by nuclear weapons. A total of 110 experts collectively spent over 1,300 hours and wrote 520,000 words developing forecasts and explaining their reasoning.

1.1 Previous forecasts of nuclear weapons risks

While our study is the largest survey collecting forecasts from nuclear weapons policy experts, it is not the first. Over the past three decades, there have been at least four other surveys asking subject matter experts to make predictions about nuclear weapons risk:

- As described in *Expert Political Judgment* (Tetlock 2005), 1988 and 1997 surveys asked non-proliferation experts and non-experts[6] about the probability of nuclear war in 10, 25,

[5] "Superforecasters" outperformed experts and intelligence analysts in forecasting tournaments held by the Good Judgment Project, or had equivalent forecasting skill according to follow-up work by Good Judgment Inc. See Philip E. Tetlock et al., "Forecasting Tournaments: Tools for Increasing Transparency and Improving the Quality of Debate," *Current Directions in Psychological Science* 23, no. 4 (2014), https://journals.sagepub.com/doi/10.1177/0963721414534257.

[6] These were non-experts or laypeople who had some interest in current affairs but lacked specialized training.

50, and 100 years.[7] Among experts, the median participant forecasted a 29% chance of nuclear war occurring in the next 50 years, while the median non-expert forecasted a 30% probability.

- In 2005, the Lugar Survey asked 79 non-proliferation and national security experts to predict the probability of a nuclear attack in the next five or 10 years.[8] The median forecast was 10% for the next five years and 20% for the next 10 years.
- A decade later, in 2015, a study by the Project for Study of the 21st Century (PS21) polled 50 national security experts on the probability of a major nuclear conflict in the next 25 years that causes more fatalities than World War II.[9] The median forecast was 5%.
- More recently, in 2022, Karger et al. ran a project called the Existential Risk Persuasion Tournament (XPT), where people with expertise in catastrophic risks (including nuclear weapons risk) and superforecasters forecasted the risk of various catastrophes and related events.[10] This included a question on the probability that nuclear weapons reduce the human population by at least 10% by 2030, 2050, and 2100. The median forecast for this outcome by 2030 was 1% for experts and 0.5% for superforecasters.[11]

Public surveys conducted in the USA, Russia, and UK show how concerned citizens are about nuclear risk. According to online surveys by Statista and YouGov, the proportion of US adults who saw a nuclear war as "very likely" or "fairly likely" within the next 10 years nearly doubled from February 28, 2022,[12] to February 2024, rising from 34% to 67%.[13] A survey conducted in 2023 asked Russian citizens whether they thought there is a threat of military conflict involving nuclear weapons in the world today, to which 71% answered "there is" and 20% answered "there is not."[14] Results from these and other relevant surveys are provided in Appendix 1.

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[7] Philip E. Tetlock et al., "Long-range subjective-probability forecasts of slow-motion variables in world politics: Exploring limits on expert judgment," *Futures & Foresight Science* 6, no. 1 (2023), https://doi.org/10.1002/ffo2.157.

[8] Richard G. Lugar, "The Lugar Survey on Proliferation Threats and Responses," FAS Intelligence Resource Program (2005), https://irp.fas.org/threat/lugar_survey.pdf.

[9] Project for the Study of the 21st Century, "Great Power Conflict Report," (Project for the Study of the 21st Century, 2015), https://projects21.org/2015/11/12/ps21-survey-experts-see-increased-risk-of-nuclear-war/.

[10] Ezra Karger et al., "Forecasting Existential Risks: Evidence from a Long-Run Forecasting Tournament" (XPT), Forecasting Research Institute, 2023, https://static1.squarespace.com/static/635693acf15a3e2a14a56a4a/t/64f0a7838ccbf43b6b5ee40c/1693493128111/XPT.pdf.

[11] Karger et al., XPT, 44.

[12] The Russian invasion of Ukraine began on February 24th, 2022.

[13] YouGov, "How likely do you think we are to get into a nuclear war within the next ten years?," survey, February 28, 2022, https://today.yougov.com/topics/politics/survey-results/daily/2022/02/28/c6993/3. Statista, "How likely do you think we are to get into a nuclear war within the next ten years?," survey, February 1 to 7, 2024, https://www.statista.com/statistics/1308926/us-opinion-likelihood-nuclear-war/.

[14] FOMnibus, "Ядерное оружие," survey, November 10, 2023, https://fom.ru/Bezopasnost-i-pravo/14942.

Event	Probability (median)	Annualized	Estimator info/ Estimator number	Date/ Retrieval date[15]	Source
Nuclear weapons will be used in combat by 2047[16]	29%	0.68%	11 nuclear experts	1997	*Expert Political Judgment studies*
	30%	0.71%	23 non-experts		
Nuclear attack occurs in the next 10 years	20%	2.2%	79 non-proliferation and national security experts	2005	The Lugar Survey
Major nuclear conflict causes more fatalities than WWII (~80,000,000) by 2030	6.8%	0.45%	50 national security experts	2015	PS21 Great Power Conflict Report
Nuclear weapons reduce the human population by at least 10% by the end of (2030, 2050, 2100)	1% (2030), 3.4% (2050), 8% (2100)	0.11% (2030) 0.12% (2050) 0.11% (2100)	12 domain experts	Jun - Oct 2022	Existential Risk Persuasion Tournament (XPT)
	0.5% (2030), 1.825% (2050), 4% (2100)	0.056% (2030) 0.063% (2050) 0.051% (2100)	88 superforecasters		

Table 1: *Existing surveys of experts eliciting forecasts of nuclear risk.*

1.2 Why develop quantitative forecasts?

Although these studies provide some evidence that nuclear experts have engaged with quantitative predictions, the community has been cautious in assigning probabilities to unlikely but catastrophic events. This is understandable given the high levels of uncertainty and the lack of historical precedents for using nuclear weapons since 1945. However, we believe that efforts to quantify these uncertain risks can serve important functions.

[15] For crowd forecasts. Retrieval date for ongoing forecasts.
[16] "Not just a warning shot - a targeting of military or civilian targets."

First, quantification can enable better understanding of viewpoints on a topic. This partly comes from providing clarity in expression. Famously, the US Joint Chiefs of Staff assessed the probability of success in the 1961 Bay of Pigs invasion at 30%. When advising President Kennedy, they communicated this as "a fair chance" of success. It was later reported that the president assumed this indicated favorable odds of success.[17] More recently, a 2018 survey found wide variation in how people interpret qualitative probability terminology. For example, the quantitative probability readers assigned to the term "a real possibility" ranged from 20% to 80%.[18] If nothing else, quantification ensures that people are speaking the same language when they share their views.

Developing more precise forecasts helps clarify areas of agreement, disagreement, and uncertainty, and assists in the comparison of potential threats and potential courses of action. As Bertrand Russell put it, being precise helps us realize and identify what is vague.[19] The process of developing quantitative forecasts can prompt a person to think more carefully through their mental models of the world and critically analyze their assumptions. Some empirical research also suggests that greater precision can result in more accurate forecasts. A 2018 study found that precise numeric forecasts became less accurate when they were coarsened into forecast ranges that were more akin to qualitative statements of probability.[20]

A potential drawback of quantification is that it can imply greater certainty than is warranted, as most people associate numbers with more concrete predictions. Therefore, when communicating numeric forecasts, experts should clarify their degree of confidence in the results and how they developed the estimates. However, without clear metrics, discussions around nuclear risks can become clouded by ambiguity or shaped by dominant perspectives. Assigning probabilities not only enhances clarity but also enables policymakers to prioritize effectively, allowing them to focus on the most urgent threats and align actions with evidence-based insights. By translating abstract concerns into measurable probabilities, engaging in informed, rational prioritization amid a chaotic and noisy political environment becomes easier.

1.3 Judgmental forecasting

Assessing the probability of highly uncertain events, like the use of nuclear weapons, is challenging. Computational models that are used for prediction in other domains (such as

[17] Peter H. Wyden, *Bay of Pigs: The Untold Story* (New York: Simon and Schuster, 1979).
[18] Andrew Mauboussin and Michael J. Mauboussin, "If You Say Something Is "Likely," How Likely Do People Think It Is?," survey, July 2018, https://hbr.org/2018/07/if-you-say-something-is-likely-how-likely-do-people-think-it-is.
[19] Cited in Kristian Skrede Gleditsch, "One without the Other? Prediction and Policy in International Studies," *International Studies Quarterly* 66, no.3 (2022), https://doi.org/10.1093/isq/sqac036.
[20] Jeffrey A. Friedman et al., "The Value of Precision in Probability Assessment: Evidence from a Large-Scale Geopolitical Forecasting Tournament," *International Studies Quarterly* 62, no. 2 (2018): 410-422, https://doi.org/10.1093/isq/sqx078.

climate change and epidemiology) cannot as readily capture the geopolitical and human factors that impact nuclear risk. Given these limitations in traditional forecasting techniques, judgmental forecasting emerges as a possible alternative.

Judgmental forecasting, relying on individuals making considered predictions, has shown promise at producing more accurate forecasts in domains where other methods have failed. Aggregating predictions from the forecasters with the best track-records has been effective in accurately predicting complex geopolitical events, economic trends, and technological developments that have eluded traditional forecasting models.[21] This approach's effectiveness was demonstrated in the Intelligence Advanced Research Projects Activity's (IARPA) Aggregative Contingent Estimation (ACE) program from 2011 to 2015. A series of geopolitical forecasting tournaments, the Good Judgment Project, used judgmental forecasting techniques to consistently outperform competitors in predicting complex events ranging from pandemics to political leadership changes.[22]

That said, the application of judgmental forecasting to catastrophic risks suffers from two salient limitations. First, empirical evidence for sustained accuracy over extended time horizons is limited. Much of the evidence for the ability of select groups of forecasters to consistently outperform chance has primarily focused on forecasts with time horizons of one to six months.[23] The longer-term forecasting that *has* been empirically studied has generally involved questions that are easier to predict due to large amounts of relevant data, such as forecasting medium-term GDP or defense spending. Second, previous efforts to forecast catastrophic events have resulted in a wide range of predictions—including some that differ by several orders of magnitude—underscoring the substantial uncertainty inherent in making these sorts of predictions.[24]

Despite these limitations, we believe that judgmental forecasting may be a useful tool in assessing the probability of highly important, but highly uncertain events.

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[21] Philip E. Tetlock, *Expert Political Judgment: How good is it? How can we know?* (Princeton University Press, 2005).
[22] Barbara A. Mellers et al., “Chapter 12. Improving the Accuracy of Geopolitical Risk Assessments,” in *The Future of Risk Management*, ed. Howard Kunreuther, Robert J. Meyer, and Erwann O. Michel-Kerjan (University of Pennsylvania Press, 2019), 209–226, https://doi.org/10.9783/9780812296228-013.
[23] Luke Muehlhauser, “How Feasible Is Long-range Forecasting?,” Open Philanthropy (2019), https://www.openphilanthropy.org/research/how-feasible-is-long-range-forecasting/.
[24] Karger et al., XPT.

2. Methods

The overarching aim of this project was to characterize views on the probability of a large-scale nuclear weapons disaster in the coming decades. We focused on understanding views about the likelihood that humanity makes it through a full century of nuclear weapons without repeat use of such weaponry. Our primary question was:

What is the probability that by 2045, one or more incidents involving nuclear weapons will cause the death of more than 10 million humans, within a 5-year time period?

Throughout this report, we use the term *nuclear catastrophe* to refer to the outcome specified in this question: one or more incidents involving nuclear weapons causing the death of more than 10 million humans within a five-year period.

We chose to focus this study on a very large-scale nuclear event for two main reasons. First, what makes nuclear weapons, of all deadly weapons, particularly horrific is their potential to cause death and destruction on a massive scale within minutes. All weapons can cause harm, but nuclear weapons are perhaps unique in their ability to cause such a catastrophic event so quickly. We wanted to focus analysis on this feature of nuclear weapons, which is a key reason why so much attention is given to nuclear weapons, relative to other weapons. Second, it seems there is a relative lack of discussion of how to prevent worst-case scenarios for nuclear weapons, compared to how to prevent any use of nuclear weapons.[25] It seems possible that the strategies and interventions that are most effective at reducing the risk of any nuclear weapon use may be different from those aimed at reducing the risk of large-scale harms from nuclear weapons (although there is likely overlap). We therefore sought to address this relatively neglected aspect of the risk of nuclear weapons.

This project had three main components:

- Interviews with a small number of highly experienced nuclear weapons policy experts
- A survey asking about risk pathways for a nuclear catastrophe
- A survey asking about policies that aim to mitigate the risk of a nuclear catastrophe

The interviews focused on identifying potential ideologically charged cruxes—that is, questions whose answers would influence views on the risk of nuclear catastrophe and where there is likely to be disagreement among experts. We used the results to develop the surveys. For a

[25] Christian Ruhl, “Philanthropy to the right of boom,” Founders Pledge (2023), https://www.founderspledge.com/research/philanthropy-to-the-right-of-boom.

detailed discussion of the interviews and the process of developing the surveys, please see Appendix 2.

2.1 Survey content

2.1.1 Survey 1

The first survey focused on risk pathways to a nuclear catastrophe. It also asked for forecasts of the probability of nuclear catastrophe by 2045, participants' beliefs about the probability of five adversarial domains causing a nuclear catastrophe, if one were to occur, and participants' beliefs about four aspects of nuclear weapons policy: the strength of nuclear deterrence, the likelihood of nuclear escalation following a first strike, the merits of aiming for total disarmament, and the proliferation risk of nuclear energy.

The main body of the survey consisted of forecasting questions that resolve in 2030. These questions asked about the probability of certain events happening by 2030. These events were intended to capture ideologically charged cruxes: events with the potential to sway clashing camps' forecasts of nuclear war. Examples of questions are shown in Box 1, and the full list of questions is provided in Appendix 3. Descriptions of questions linked to information sheets, which linked to information that we thought forecasters would likely seek out to inform their forecasts.

Box 1: Examples of 2030 Crux Questions

- What is the probability of a [x] non-test detonation of a nuclear weapon occurring before the 1st of January, 2030?
  - a) Accidental
  - b) Inadvertent
  - c) Deliberate
- What is the probability that [x] conducts a nuclear weapons test or comes into possession of nuclear weapons before the 1st of January 2030?
  - a) Iran
  - b) Any state other than Iran, that is not currently believed to have nuclear weapons
  - c) A non-state actor
- What is the probability that, by the 1st of January 2030, the US will have formally announced its intention to withdraw from NATO?
- What is the probability that, by January 1st 2030, there will have been more than 500 deaths in militarized conflict between [adversarial domain] in one calendar year?

Some of the questions were general, but some related to specific countries or adversarial domains. Participants were asked to choose one of four adversarial domains according to their expertise. The four domains were:

- China and the USA
- India and Pakistan
- Korean Peninsula
- Russia and NATO

Participants were then randomly assigned a second domain. Due to the high number of participants choosing the Russia and NATO domain, we altered the survey settings soon after the survey began so that this domain would not be randomly assigned. Every participant answered questions on 14 general topics, plus questions on one additional topic per domain. The exact number of questions answered depended on chosen and allocated domains.

For each question, participants gave a forecast of the probability that the question would resolve positively (i.e. that the event would occur), and then provided a forecast of the probability of a nuclear weapons catastrophe conditional on the question resolving positively, and the probability conditional on the question resolving negatively.

2.1.2 Survey 2

The second survey focused on policy responses to nuclear weapons risk. Using the results from interviews, the first survey, and policy suggestions published by organizations working on nuclear issues,[26] we developed a list of potential policies to ask about. Out of this list, policies for the second survey were selected with input from analysts from the Open Nuclear Network and other external advisors. Policy selection was based on the policies' potential to influence nuclear catastrophic risk, their interest to the nuclear weapons policy community, their practicability, and likelihood of implementation.

As with the first survey, participants were asked to choose an adversarial domain according to their expertise. Participants were not allocated an additional domain for the second survey. We investigated views on 23 different policies, including six general policies (i.e., not specific to any adversarial domain) and some domain-specific policies. For most domains, we included three domain-specific policies. As we anticipated a greater number of respondents electing to answer questions on the Russia and NATO domain, we included eight policies specific to this domain, although each participant only provided answers for three of these eight policies. These policies are listed briefly in Box 2 and described fully in Appendix 4.

Box 2: Policies included in Survey 2

- General (answered by all participants)

[26] These organizations included but were not limited to Nuclear Threat Initiative, Arms Control Association, Founders Pledge, Open Philanthropy, Carnegie Endowment, Chatham House, and the Union of Concerned Scientists.

    - All nuclear-armed states sign and ratify the Comprehensive Test Ban Treaty
    - All nuclear-armed states conduct a failsafe review
    - A secure multilateral crisis communications network is established with all nuclear-armed states participating
    - A Fissile Material Cut-off Treaty is signed by all of the P5 countries and India and Pakistan
    - The USA removes the President of the United States' sole authority to authorize the use of nuclear weapons
    - P5 states 1) jointly develop a risk assessment framework for the use of AI models in nuclear command, control and communication systems, and 2) agree to a moratorium on the use of high-risk AI models in NC3 systems

- China and the USA domain
    - The USA implements a no-first-use policy
    - The USA and China sign a missile launch notification agreement
    - China and the USA establish regular, high-level nuclear dialogue

- India and Pakistan domain
    - India and Pakistan formalize their low-alert status and agree to maintain their ground-based nuclear weapons in a de-mated state
    - India and Pakistan establish a mechanism to conduct regular exchanges of information on nuclear and military matters
    - An India-Pakistan Nuclear Risk Reduction Center has been established

- Korean Peninsula domain
    - The USA declares that it will not conduct left of launch attacks on North Korean nuclear command, control and communications systems
    - The United States establishes a liaison office in Pyongyang, North Korea, to facilitate communication, diplomacy, and engagement with the North Korean government
    - The USA and North Korea establish Track 1.5 diplomacy to facilitate regular dialogue and cooperation

- Russia and NATO domain
    - Russia and the USA sign an arms control treaty succeeding New START
    - Russia and the USA agree on limits or bans for intermediate-range missiles
    - The USA eliminates its launch-on-warning posture
    - Russia eliminates its launch-on-warning posture
    - The USA decreases the role of nuclear weapons with a yield of less than 50 kt in its nuclear posture
    - Russia decreases the role of nuclear weapons with a yield of less than 50 kt in its nuclear posture
    - The USA increases the role of nuclear weapons with a yield of less than 50 kt in its nuclear posture
    - Russia increases the role of nuclear weapons with a yield of less than 50 kt in its nuclear posture

We asked participants to say whether (and how) the implementation of these policies would influence their forecast of the probability of nuclear catastrophe. We asked participants to only consider the causal effects of the policy, rather than what such a policy being implemented would say about the state of the world. For example, someone might reduce their forecast of nuclear catastrophe for two reasons if they knew an arms control agreement between the USA and Russia would be implemented: i) the limitations of the agreement might reduce the number of weapons available to use, or ii) the fact that the USA and Russia reached an agreement might signal improved relations between the countries. We asked participants to only include the first consideration, not the second.

In addition to forecasting the effect of the policies on the probability of nuclear catastrophe by 2045, we also asked participants to forecast the probability that, within the next three years, action would be taken to implement the policy. We asked participants to give an unconditional forecast, and to give their forecast of this probability conditional on a nonprofit team being given $500 million dedicated to getting the policy implemented.

Participants were asked to rank the policies according to how much they would like them to be implemented and how much they would like $500 million of funding to go to attempts to have the policy be implemented. We also asked about other effects (other than effects on the probability of a nuclear catastrophe) of the policies, including other positive and negative effects.

2.1.3 Reciprocal scoring

Because most of the questions participants were asked to forecast in this study won't resolve for many years, we included some questions to give an earlier indication of participant accuracy. This included some questions that will resolve in 2026 (see Appendix 3), and some questions that asked participants to predict the forecasts of other participants. Specifically, we asked all participants to predict what the median expert in the study would forecast for the probability of nuclear catastrophe in 2045, and to predict the median expert's forecast on five of the crux questions that will resolve in 2030.[27] We used these results to generate "reciprocal scores" for each participant. Forecasts elicited this way can be as accurate as forecasts incentivized using comparisons to the truth.[28]

2.2 Recruitment

The two main participant groups for the survey were people with expertise relevant to nuclear weapons policy (we use the term *experts* for this group), and people with a strong track record of accurate forecasting.

[27] Each participant was allocated five of the general (i.e. not domain-specific) crux questions.
[28] Ezra Karger et al., "Reciprocal Scoring: A Method for Forecasting Unanswerable Questions," *SSRN* (2021), http://dx.doi.org/10.2139/ssrn.3954498.

We recruited subject matter experts through three channels: advertisement via relevant professional organizations,[29] review of staff pages of websites of relevant organizations and author lists of relevant reports,[30] and snowball sampling that asked prospective participants to nominate other people who may be appropriate participants. In an effort to capture viewpoint diversity, we asked people to nominate two people who they thought would largely agree with their views on nuclear risks and two people who they thought would largely disagree with them.

Ultimately, we emailed 514 subject matter experts (who we thought might meet our requirements) directly about the survey, and likely reached more through the general approaches to advertisement described above.

To ensure that our sample of subject matter experts reflected the population that would generally be considered "expert," we required expert participants to have a minimum of five years of experience relevant to nuclear weapons policy (or two years and a relevant graduate degree). To ensure that our subject matter experts met this bar, we invited interested experts to register their interest in participating through completing a form that asked for details of their relevant education and professional experience. 239 people registered their interest in the study. Of these, 171 met the required level of experience and were invited to complete the surveys. 110 experts completed the first survey and all but one of these completed the second.

We recruited accurate forecasters by directly inviting so-called "superforecasters"—people who have been shown to be highly accurate forecasters and outperformed experts and intelligence analysts in large-scale forecasting tournaments held by the Good Judgment Project and subsequent forecasting exercises run by Good Judgment, Inc.[31] A total of 55 superforecasters initially expressed interest in the study and were invited to participate. Of these, 41 completed the first survey, and 39 of these completed the second.

We also recruited members of the public to complete a shortened version of the surveys. These were previous participants in studies run by the Forecasting Research Institute, recruited via Facebook ads targeting people interested in global news, geopolitics, and other topics. We report some key findings from this public survey for the purpose of comparison with the responses from the expert and superforecaster participants. However, this report focuses on the results of the expert and superforecaster surveys.

2.3 Participant compensation

[29] Organizations that kindly helped with distribution of the survey were: Emerging Voices Network at BASIC, European Leadership Network, Asia Pacific Leadership Network, Younger Generation Leaders Network, Project on Nuclear Issues at CSIS, and the Pacific Forum.
[30] A full list of the organizations and reports we reviewed is available in Appendix 2.
[31] Philip E. Tetlock et al., "Forecasting Tournaments: Tools for Increasing Transparency and Improving the Quality of Debate," *Current Directions in Psychological Science* 23, no. 4 (2014): 290–295, https://doi.org/10.1177/0963721414534257.

We provided an honorarium of $250 to expert and superforecaster participants who completed both surveys to compensate them for their time. Participants who chose to spend more time on the surveys were paid an additional $50/hour for self-reported hours of work above five hours, up to a maximum of 10 additional hours. Participants who spent more than 10 hours on the first survey were awarded an additional $100 for completing the second survey. We incentivized high quality engagement in the survey by offering additional monetary prizes, which will be awarded on the basis of the quality of text rationales given for forecasts and accuracy on some forecasting questions. Prior to the awarding of these additional prizes, participants received an average of $525 to compensate them for the time spent completing the two surveys.

For the shortened survey of the public, we recruited people who had been participants in previous studies run by the Forecasting Research Institute by email invitation. Members of the public received a payment of $20 for each of the two surveys they completed.

2.4 Survey engagement

Participants completed Survey 1 between March and May 2024 and Survey 2 between June and August 2024. There was generally a high level of engagement with the surveys. The median expert or superforecaster participant reported spending nine hours completing the two surveys. Superforecasters spent a longer time on the surveys than did experts. The median superforecaster spent approximately 13 hours on the surveys and the median expert spent around 7.5 hours. Superforecasters also wrote more words in their rationales (a median of roughly 4,900, compared to an expert median of roughly 3,800). Collectively, expert and superforecaster participants wrote over 747,000 words in their rationales.

3. Participants

Key points

- 151 participants (110 experts and 41 superforecasters) completed the first survey and 148 (109 experts and 39 superforecasters) completed the second.
- Experts largely worked in think tanks and academia, and had a median of nine years of relevant experience.
- Participants were from 37 different countries, although around a quarter of experts and half of superforecasters were born in the USA.
- 36% of experts think that nuclear deterrence is robust, 33% think it is fragile, and 30% think it is fragile at present but could be robust in the future.
- 56% of experts think that nuclear escalation is very likely following a nuclear first strike, 16% think that escalation can be prevented, and 27% are very uncertain about whether escalation would occur.

A total of 151 participants completed the full first survey. This included 110 expert participants and 41 superforecaster participants. Of these, three participants (one expert and two superforecasters) did not complete the second survey, so a total of 148 participants completed both surveys (109 experts and 39 superforecasters). Here we present details of the 151 participants who completed at least the first survey.

3.1 Demographics

3.1.1 Age and gender

The age and gender breakdown of both participant groups are shown in Figure 3. The majority of participants identified as male, with 69% of expert participants and 93% of superforecasters identifying as male.[32] Proportionally, the expert group was younger than the superforecasters, with 20–34 years old being the most common age category for experts, accounting for 40% of

[32] We believe that this very low proportion of female superforecaster participants is largely a function of recruitment from the study that originally identified superforecasters among a broad population of participants (Barbara Mellers et al., "Psychological Strategies for Winning a Geopolitical Forecasting Tournament," *Association for Psychological Science* 25, no. 5 (2014): 1108. https://doi.org/10.1177/0956797614524255.) Of the participants in that study, 83% were male.

expert participants. The most common age category for superforecasters was 45–54 years old, which accounted for 29% of these participants.

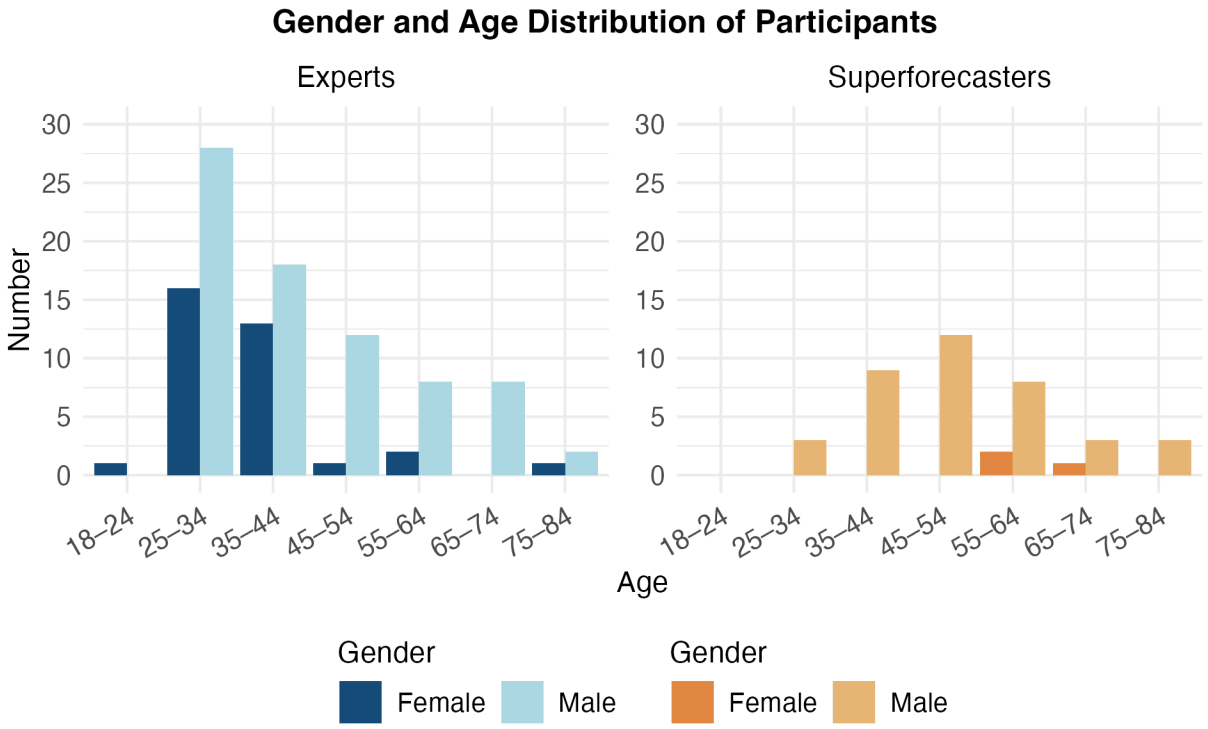

Figure 3: *Age and gender distribution of expert and superforecaster participants.*

3.1.2 Geographic region

The USA was the most common country of birth of participants. This was particularly true for the superforecaster group, 49% of whom were born in the USA. The USA was still the most common country of birth for experts, but it accounted for only 25% of the participants. The next most common country of birth was Pakistan, where 15% of expert participants were born. Figure 4 shows the most common countries of birth for expert participants. For more detail on the country of origin and country of residence of participants, please see Appendix 5.

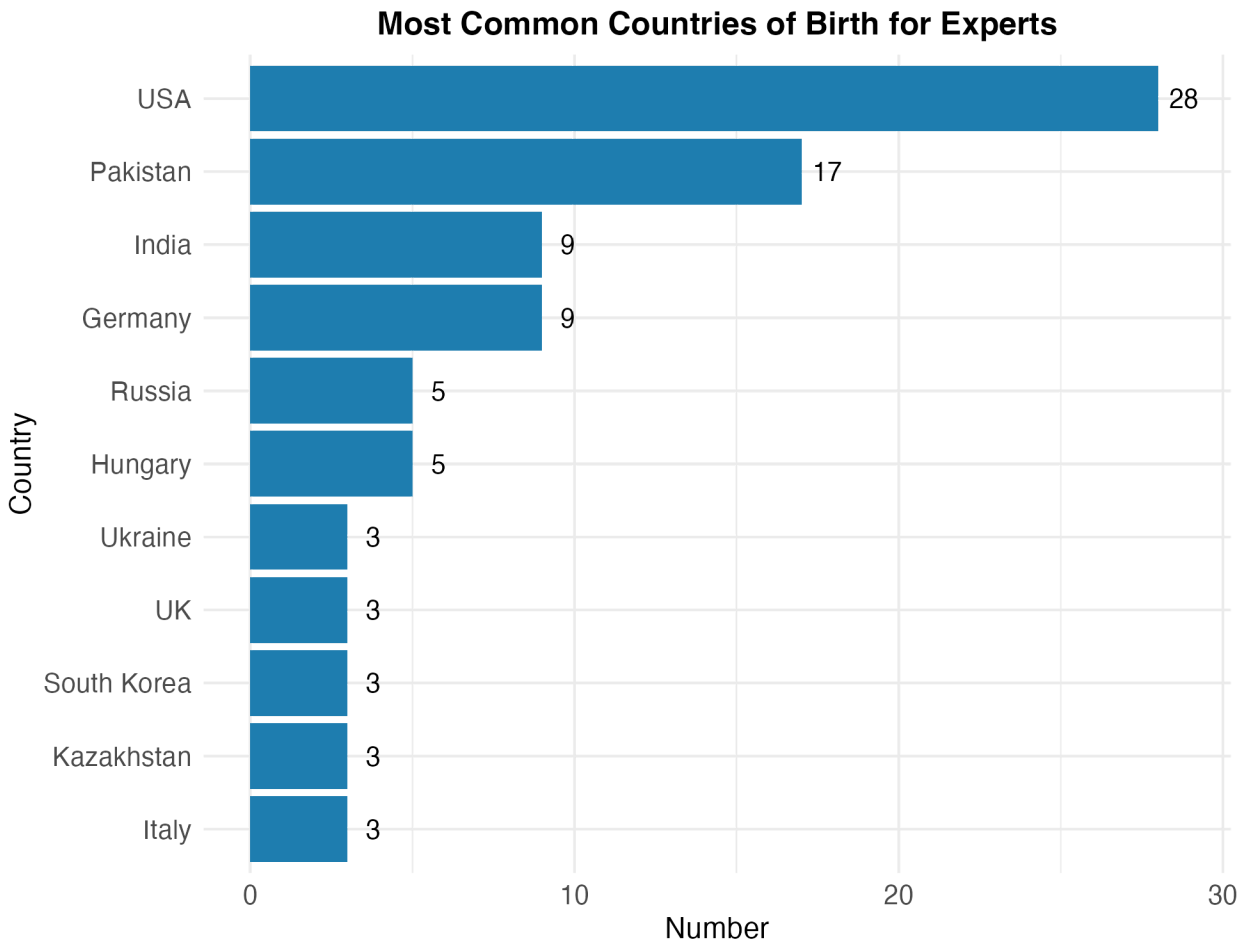

Figure 4: *Count of experts born in the most common countries of birth for expert participants.*

3.2 Expertise

Expert participants were required to have a minimum of five years of experience working in a field relevant to nuclear weapons policy, or to have two years of relevant work experience as well as a relevant graduate degree (master's or doctorate). The distribution of years of experience is shown in Figure 5.

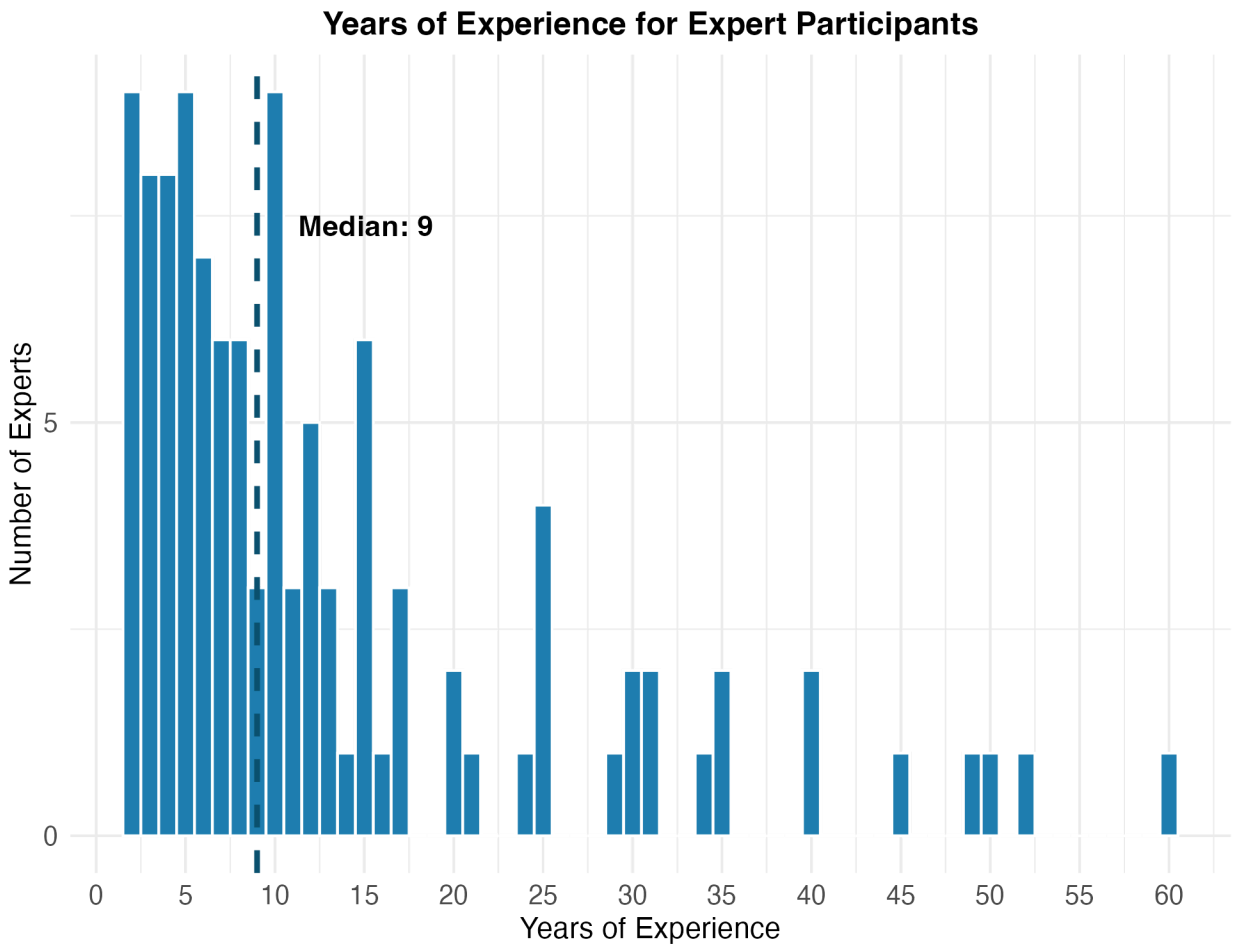

Figure 5: *Distribution of years of experience of experts.*

We asked experts to list the organizations they were affiliated with. We then classified these organizations into several types. Figure 6 shows the distribution of these organizational affiliations. Academic institutions and think tanks were the most common type of affiliation. Many experts were affiliated with more than one type of organization.

We also asked experts about postgraduate education relevant to nuclear weapons policy. The majority of expert participants (86%) had a relevant postgraduate degree (master's or PhD). The most common field of study was international relations, with 36 experts holding at least one graduate degree in this field. This was followed by security studies and political science. Many experts combined two or more of these fields of study.

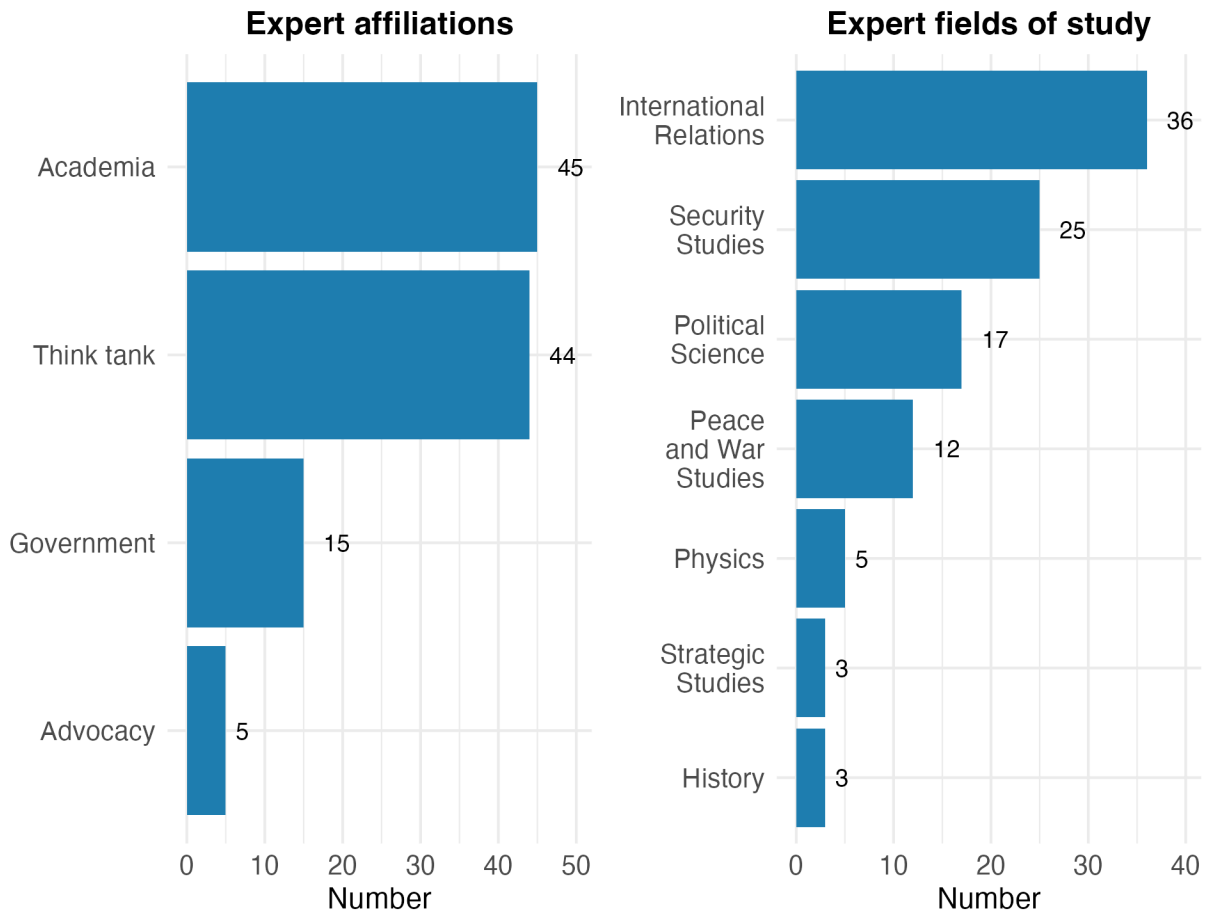

Figure 6: *Type of organizational affiliations and fields of study of experts.*

3.3 Beliefs about contentious issues

We asked participants about four issues in order to capture important ideological differences about nuclear weapons policy:

- The fragility / robustness of nuclear deterrence
- The likelihood that a nuclear strike would be met with nuclear retaliation
- The proliferation risk posed by nuclear energy
- The desirability of complete nuclear disarmament

For each of these issues we asked participants to rank three statements representing different viewpoints on the issue. Two of these statements were intended to represent two opposing views and one was intended as a "middle ground" between the opposing views. As an example, the statements for the "nuclear deterrence" issue are shown in Box 3, and the full list of statements is available in Appendix 6.

Box 3: Statements for assessing views on nuclear deterrence

- Opposing view 1: Nuclear deterrence is inherently fragile (easily shattered by human irrationality and chance events—so not a reliable safeguard against nuclear war).
- Opposing view 2: Nuclear deterrence can be robust with clear communications, tight command and control, and mutually assured destruction.
- Middle-ground view: Nuclear deterrence could be effective, but the current state of global communication, command and control systems, and weapon deployment are easily fallible, and so deterrence is not a safe system at present.

Figure 7 shows the distribution of experts and superforecasters who selected each of the statements as most representative of their views. There were no statistically significant differences between the proportions of the two groups choosing each statement (see Appendix 5 for details).

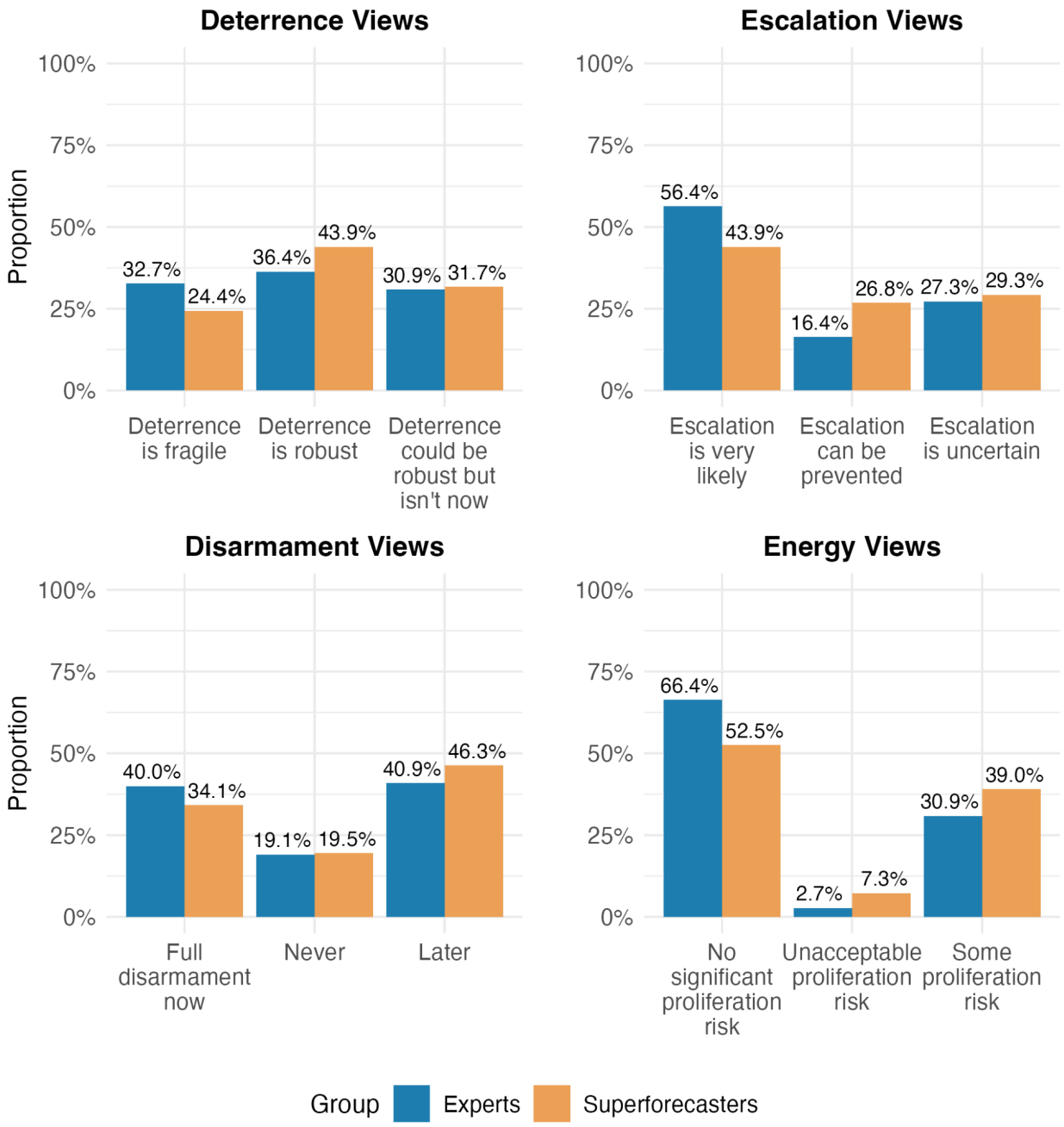

Figure 7: *Proportion of respondents selecting each statement as the closest match (of the three) to their own view on four nuclear weapons policy issues: views on the nuclear deterrence, views on nuclear escalation risk, views on the goal of total disarmament, views on the proliferation risk of nuclear energy programs. See Appendix 6 for full issue statements.*

4. Forecasts of nuclear catastrophe risk

Key points

- The median expert forecast for the probability of a nuclear weapons incident killing more than 10 million people before 2045 was 5%. The median superforecaster's forecast was 1%, and the median member of the public's forecast was 10%.
- Conditional on a nuclear weapons catastrophe occurring by 2045, on average experts forecast a 26% probability that Russia and NATO would be the cause, roughly 20% for both the Korean Peninsula and India and Pakistan, and roughly 13% for both Israel and Iran, and China and the USA.
- Violent conflict and new actors acquiring nuclear weapons were the events associated with the highest increase in risk.
- For many participants many of the events wouldn't influence risk including: an accidental non-test detonation, no-first use policies, summits between adversarial countries, and more.

Here, we present key findings from the forecasting components of the surveys. For most questions we present the median response from the expert and superforecaster participants. This represents the mid-point of the group responses; half the group's responses are higher than this value and half are lower than this value.[33]

There are many ways to aggregate forecasts, but we choose the median because it is straightforward to calculate, transparent, robust to extreme outlying observations, and easier to understand than most other methods. Also, reassuringly, in previous work we have found that it is never the highest nor the lowest of several aggregation methods that were considered.[34]

[33] In some places, we report the average or mean. These are instances where participants are asked to distribute votes, ranks, or probabilities (i.e., saying how likely several mutually exclusive but collectively exhaustive events are, such that the total probabilities sum to 100%).
[34] Karger et al., Existential-Risk Persuasion Tournament, 20-22.

4.1 Probability of nuclear catastrophe

Participants were asked to answer the following question:

> *"What is the probability that by 2045, one or more incidents involving nuclear weapons will cause the death of more than 10 million humans, within a five-year time period?"*

The median expert forecast was 5% (IQR: 1–18.5%) and the median superforecaster response was 1% (IQR: 0.15–2.3%). There was substantial variation in forecasts within both groups, although this was more pronounced for experts, where the standard deviation was 18.4%, compared to 5.3% for superforecasters. The median forecast from our survey of the public was 10%, with a standard deviation of 24.9%.

Table 2 and Figure 8 summarize the responses to this question from experts, superforecasters and members of the public. Figure 9 shows the distribution of responses from experts and superforecasters. Figure 10 shows the proportion of expert and superforecaster responses that fall within different ranges.

Group	Number of respondents	Median forecast	Interquartile range (IQR)	Standard Deviation (SD)
Experts	110	5%	1–18.5%	18.4%
Superforecasters	41	1%	0.15–2.3%	5.3%
The public	401	10%	1–35%	24.9%

Table 2: *Summary of forecasts on the probability of nuclear catastrophe from experts, superforecasters and the public.*

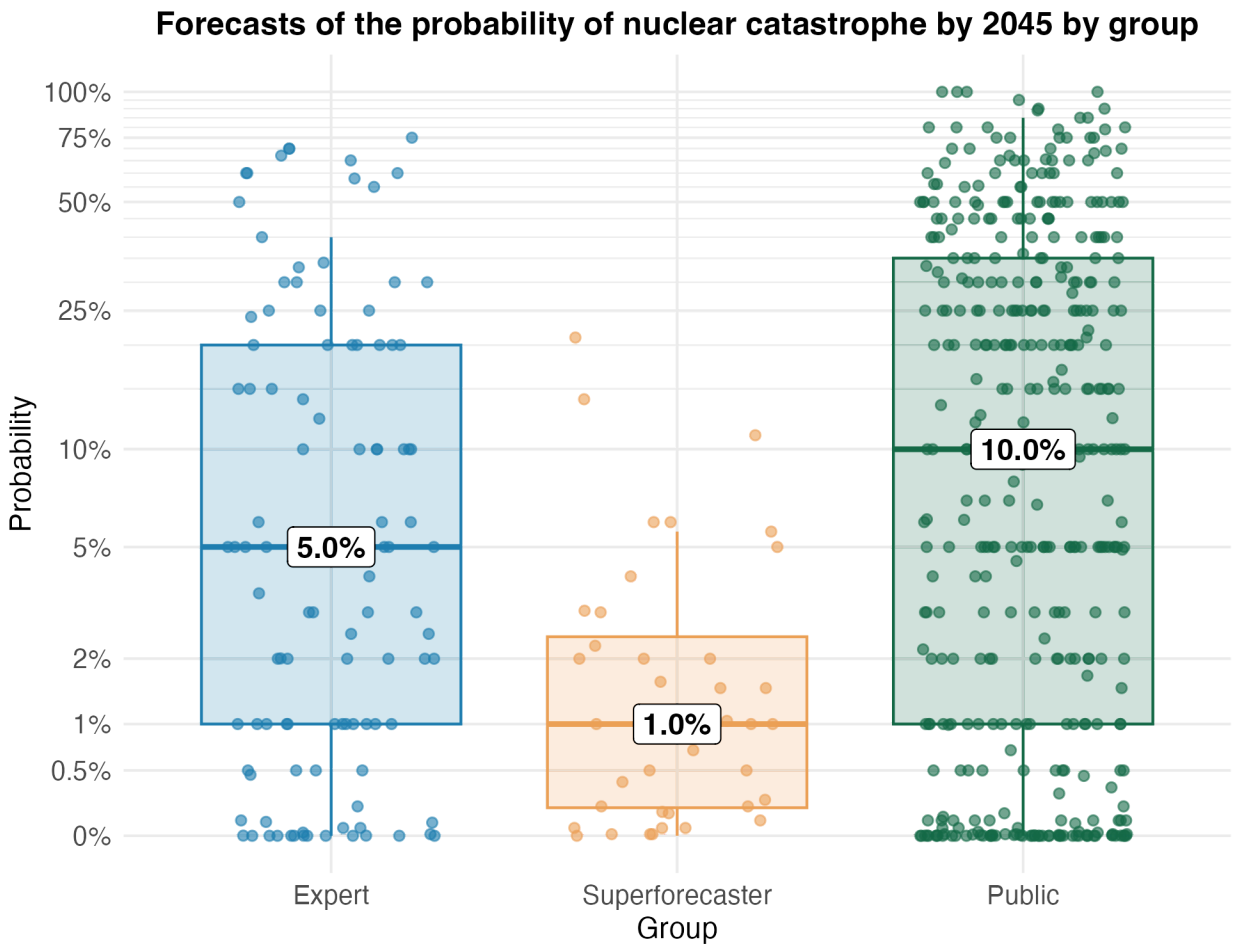

Figure 8: *Plots show forecasts of the probability of nuclear catastrophe by 2045. The median forecast is provided in text. The boxes show the 25th–75th percentile forecasts, and the lines the range of forecasts minus outliers. We jitter the data points horizontally to allow for better visualization of the distribution of forecasts. Horizontal variation within each group serves no other empirical purpose. The y-axis uses a logarithmic scale to informatively show variation in forecasts in the 0–10% range.*

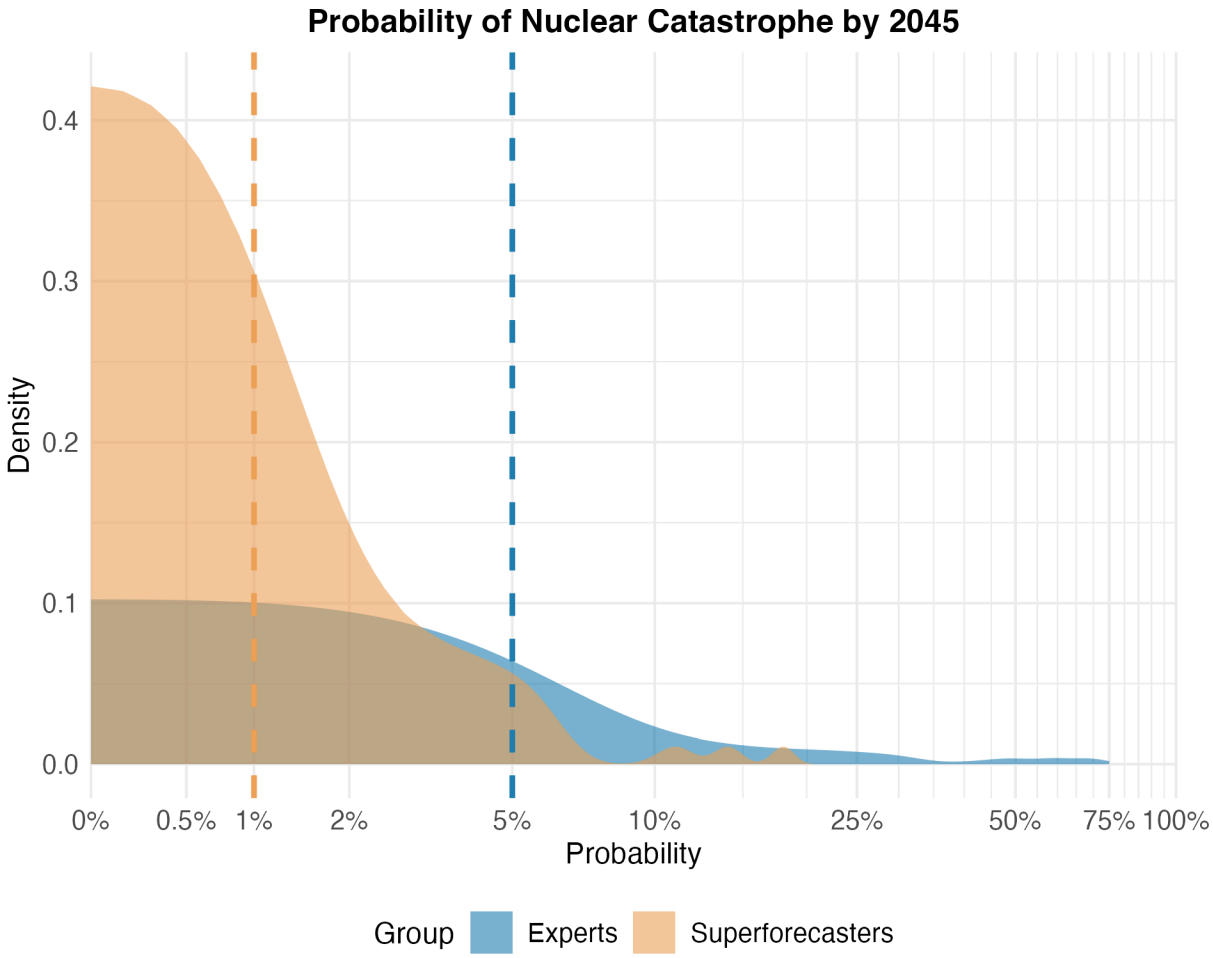

Figure 9: *Density plot showing the distribution of forecasts of the probability of nuclear catastrophe for expert and superforecaster participants. The dashed line shows the median forecast for each group. The x-axis uses a logarithmic scale to informatively show variation in forecasts in the 0–10% range.*

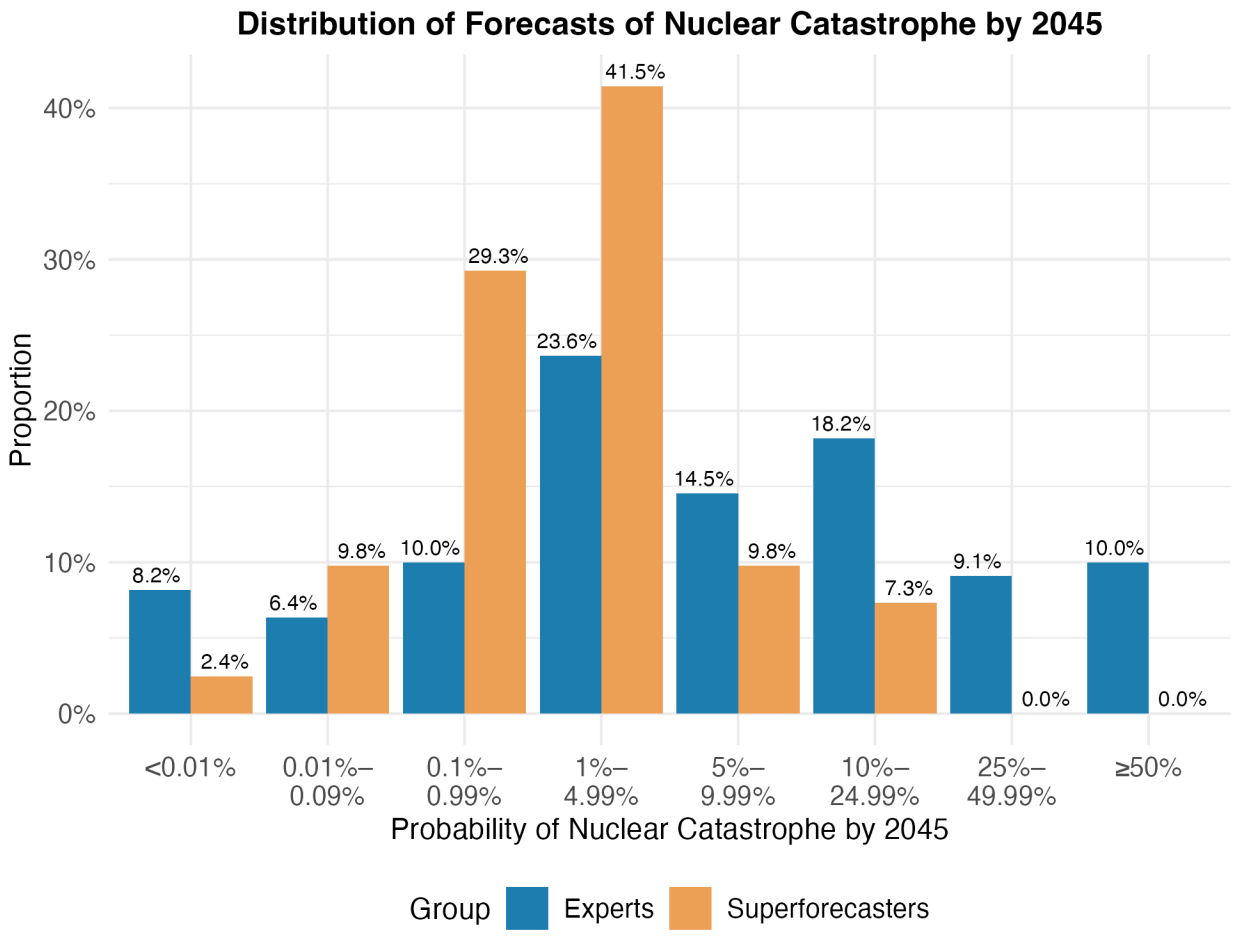

Figure 10: *Plot shows the proportion of respondents whose forecasts of the probability of nuclear catastrophe by 2045 fall into each of the ranges.*

Participants were also asked to provide a rationale for their forecasts. Respondents who forecasted a higher probability for nuclear catastrophe pointed to increased tensions and ongoing conflicts between nuclear powers, especially between Russia and NATO, China and the USA, and India and Pakistan. Many suggested that nuclear weapons proliferation, new military technologies, and weakening of international arms control agreements heighten risk. These rationales also expressed concerns that disinformation and misunderstanding could lead to escalation.

Rationales for lower probability estimates emphasized that there has been no use of nuclear weapons since 1945. They also argued that the doctrine of mutually assured destruction disincentivizes using nuclear weapons even in times of conflict, and that most decision makers are rational actors who wish to avoid catastrophic outcomes. According to some participants, a death toll of 10 million would require an extensive nuclear exchange where major cities are targeted, which they deemed unlikely. They also cited improvements in safety mechanisms, which reduce the likelihood of inadvertent and accidental use. A more detailed summary of the arguments provided for different ranges of forecasts is provided in Appendix 7.

4.2 Risk from specific adversarial domains

Participants were asked which of the adversarial domains would be most likely to have been the primary cause of a nuclear catastrophe (that killed more than 10 million people), if such a catastrophe were to occur before 2045. They were asked to allocate probabilities among five adversarial domains—Russia and NATO, China and the USA, the Korean Peninsula, India and Pakistan, and Israel and Iran—and an "Other" category. The average probability allocated to each domain is shown in Figure 11.[35]

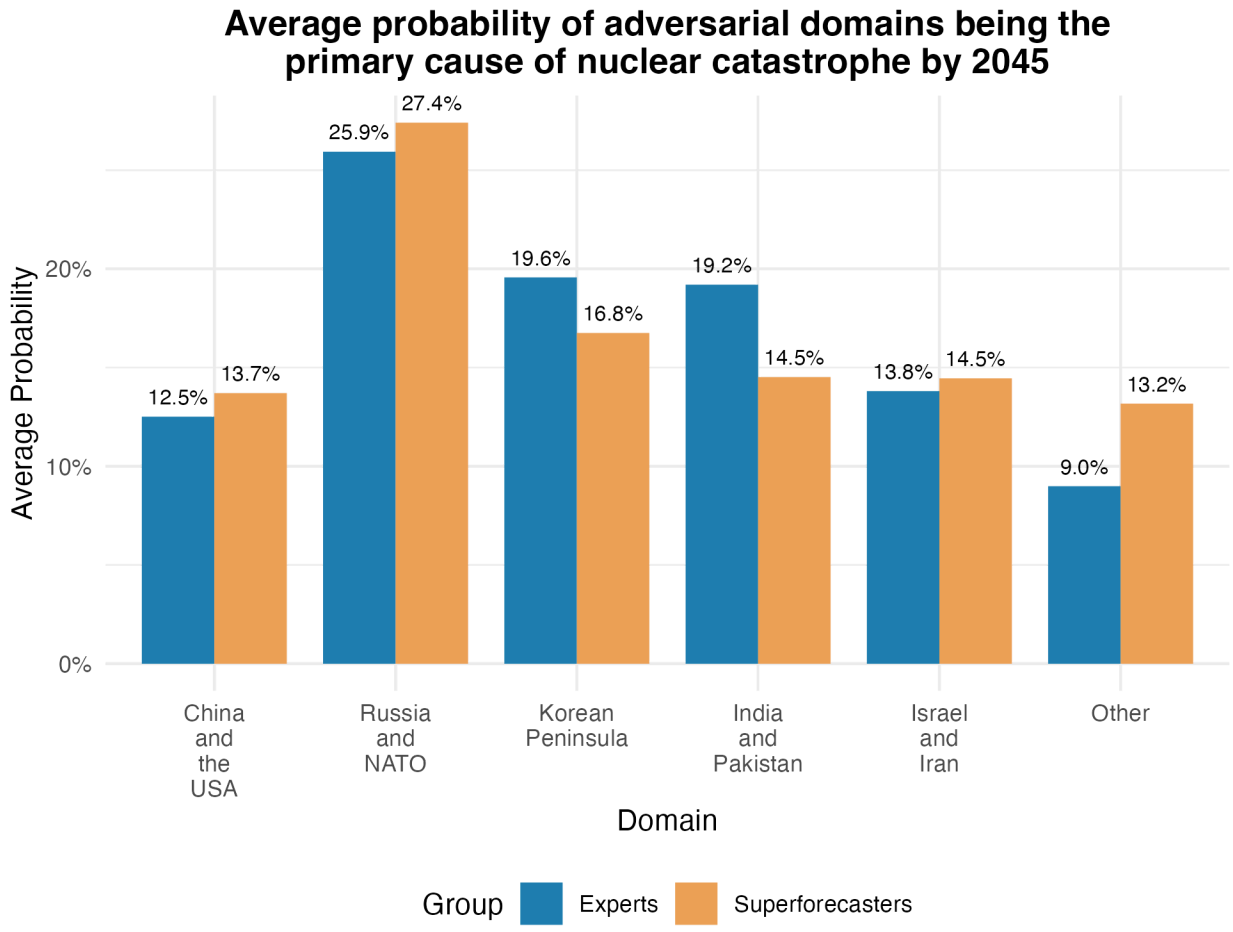

Figure 11: *Plot shows the average probability placed on domains being the primary cause of a nuclear catastrophe by 2045.*

[35] Here we report averages, rather than medians, as the aggregate group measure. This is done so that the totals across the domains sum to 100%.

We tested whether expert participants were more likely to forecast a higher probability that their chosen domain would be the primary cause of catastrophe. The results are shown in Table 3. Although there was a trend to give higher forecasts for three of the domains (all except India and Pakistan) when experts chose that domain, the only statistically significant difference was for experts choosing the Korean Peninsula domain.

Adversarial domain	**Median forecast from experts choosing domain**	**Median forecast from experts not choosing domain**	**P-value from Mann-Whitney U test***
China and the USA	15% (n=12)	10% (n=98)	0.95
Russia and NATO	25% (n=56)	20% (n=54)	0.55
India and Pakistan	15% (n=27)	15% (n=83)	1
Korean Peninsula	28% (n=15)	20% (n=95)	0.01

Table 3: *Views of the probability of domain being most likely cause of catastrophe disaggregated by whether experts chose the domain. *This test was performed with a Bonferroni correction.*

4.3 Risk pathways

We asked participants questions about the probability of various events occurring by 2030. These questions were intended to represent potential ideological cruxes, by which we mean questions whose answer would influence participants' assessment of the risk of nuclear catastrophe by 2045. For each question, participants were asked for their forecast on the likelihood of the event occurring and to describe how their forecast of the probability of nuclear catastrophe by 2045 would change conditional on the event occurring and conditional on the event not occurring.[36] The full list of questions is available in Appendix 3.

In response to these questions, some participants gave forecasts that were incoherent. For example, if a participant's forecast of catastrophe conditional on an event occurring is lower than their unconditional forecast of catastrophe, then their forecast of catastrophe conditional on the event **not** occurring cannot also be lower than their unconditional forecast of catastrophe. (Similarly, the forecast of catastrophe conditional on the event occurring and conditional on the event **not** occurring cannot both be higher than the unconditional forecast of catastrophe). When respondents gave forecasts that were incoherent in this way, or contradicted their written

[36] Participants were also asked how their probability of nuclear catastrophe by 2045 would change if they knew that this event would occur. Therefore, these changes in forecasts shouldn't be taken as representing the causal effect of the event. For example, it's possible that a participant who would reduce their probability of catastrophe if an arms control agreement occurred might not think that the agreement itself would cause any change in risk. Instead, they might think that an arms control agreement would indicate that the relationship between the countries has improved, and they might reduce their predicted risk of catastrophe for that reason.

rationales, we dropped these responses from the analysis. For this reason, the number of respondents varies between the questions. Fewer than 5% of forecasts analyzed in this report were dropped from the dataset due to incoherence. While 50 of the 151 respondents had at least one of their forecasts dropped, this is not surprising given the length of the survey, which required that participants submit forecasts and rationales for a median of 9 hours. For more detail on how we managed incoherent responses, please see Appendix 8.

Perhaps unsurprisingly, deliberate and inadvertent non-test nuclear weapons detonations were associated with a large increase in risk of nuclear catastrophe, as were violent conflicts between nuclear-armed states and horizontal proliferation of nuclear weapons to new actors. Here we discuss how forecasts of nuclear catastrophe by 2045 change conditional on these and other events that might influence risk.

4.3.1 Accidental, inadvertent, and deliberate non-test detonation

To understand views on different risk pathways, we asked participants how their forecast of nuclear catastrophe would change if they knew that an accidental, inadvertent, or deliberate non-test nuclear weapon detonation occurred by 2030. For these questions, we took our definition of the different types of non-test detonation from Barrett, Baum and Hostetler (2012).[37] An accidental detonation is one where "system safeguards or procedures to maintain control over nuclear weapons fail in such a way that a nuclear weapon … explodes without direction from leaders." An inadvertent detonation is one in which the attacking group "mistakenly concludes that it is under attack and launches nuclear weapons in what it believes is a counterattack." A deliberate detonation is one in which "the attacking nation decides to attack based on accurate information about the state of affairs." Figure 12 shows how forecasts on the probability of catastrophe change conditional on each type of detonation occurring by 2030.

[37] Anthony M. Barrett et al., "Analyzing and Reducing the Risks of Inadvertent Nuclear War Between the United States and Russia," *Science & Global Security* 21, no. 2 (2012): 107, https://doi.org/10.1080/08929882.2013.798984.

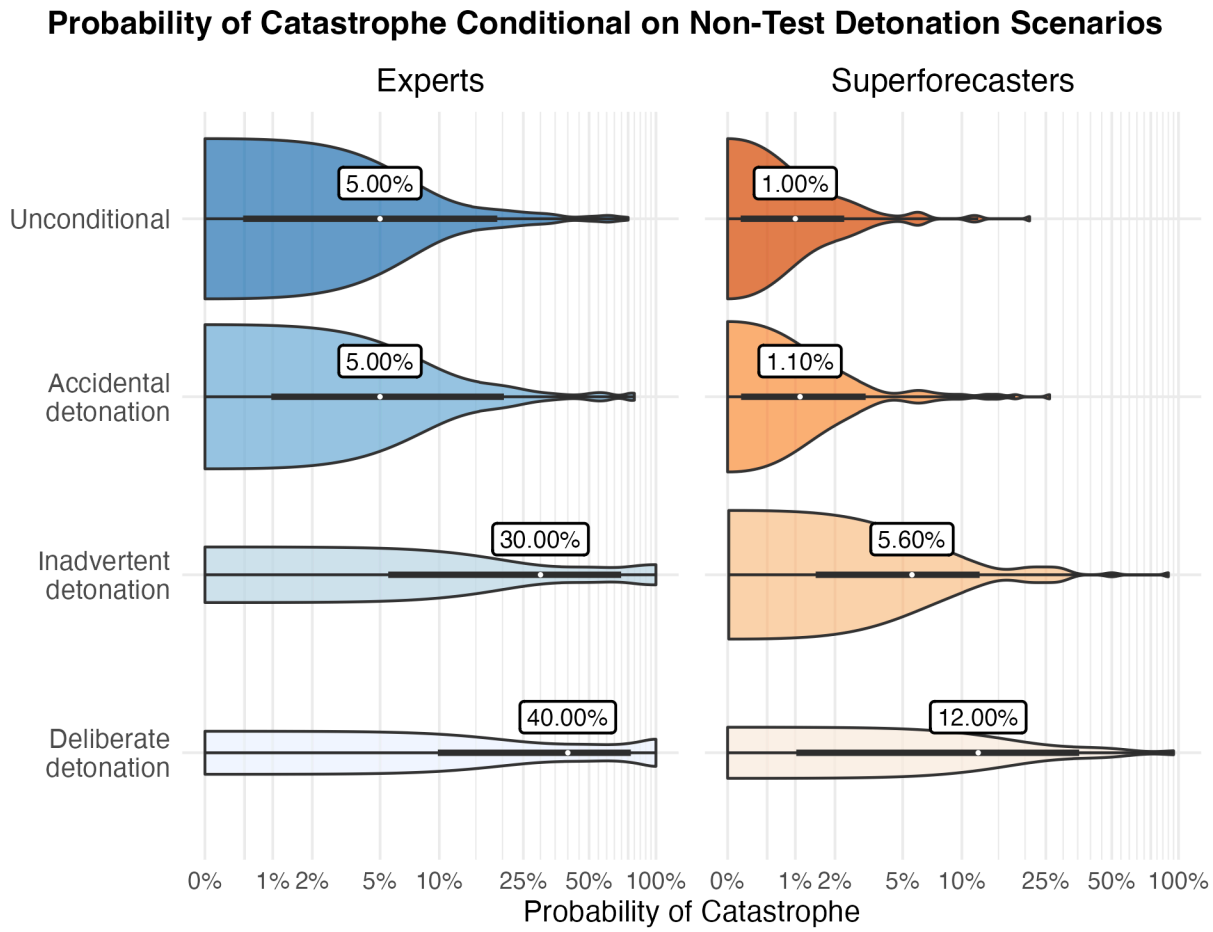

Figure 12: *Violin plots showing distribution of forecasts of the probability of nuclear catastrophe, unconditional and conditional on different types of non-test nuclear detonations occurring before 2030. The group median is shown in text. The thicker bar within each violin shows the interquartile range (25th to 75th percentile forecasts), and the thin line shows the range of forecasts minus outliers.*

Deliberate and inadvertent non-test detonations were associated with a large increase in forecasts of catastrophe. The median expert would increase their forecast of catastrophe by four times, conditional on a deliberate non-test detonation occurring. The median superforecaster would increase theirs by 6.7 times. Conditional on an inadvertent detonation, the median expert and the median superforecaster would triple their forecast. Figures 13 to 15 show how participants' forecasts of nuclear catastrophe change conditional on a deliberate non-test detonation occurring by 2030.

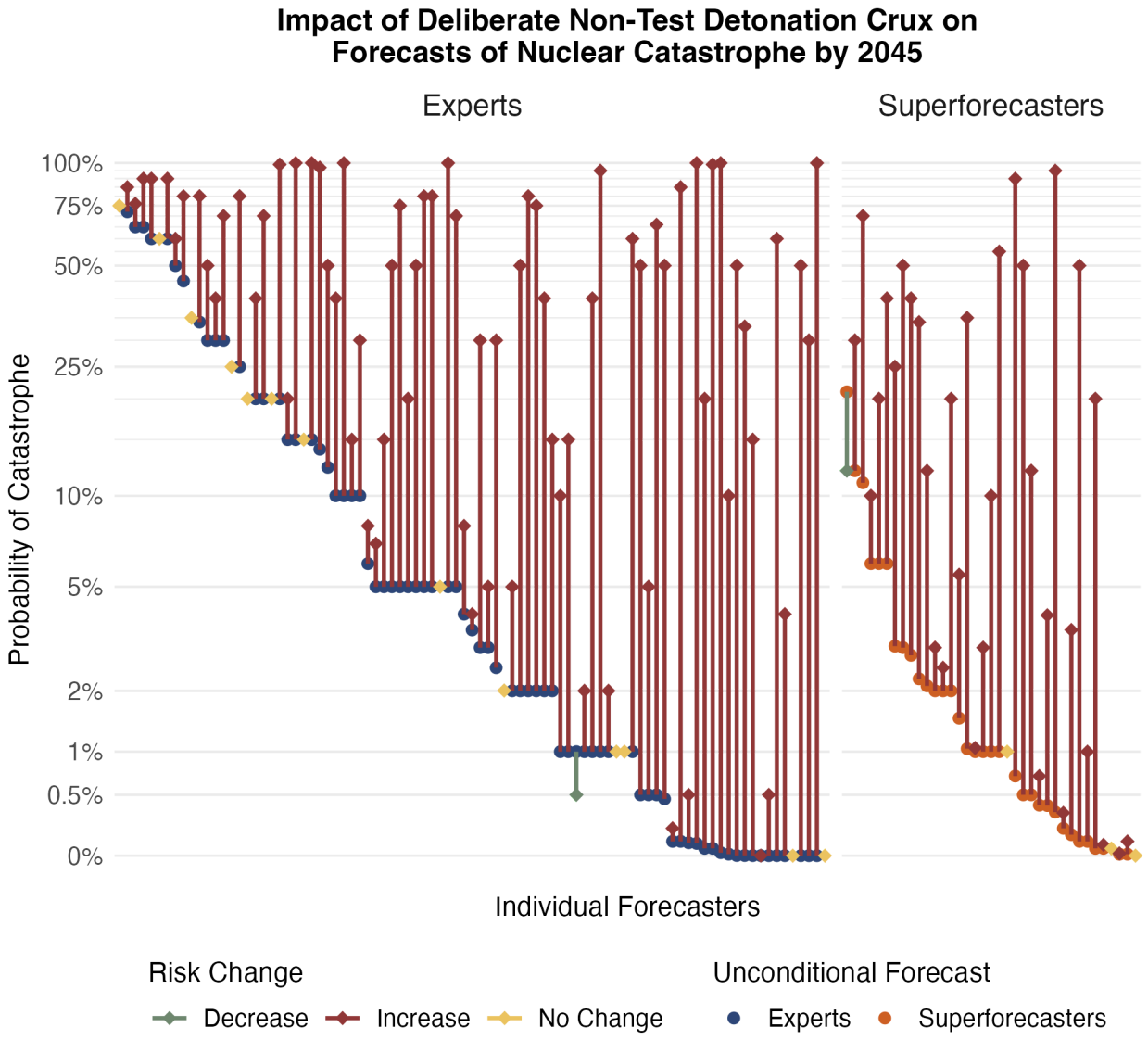

Figure 13: *Plot shows how individual respondents' forecasts of nuclear catastrophe would change conditional on a deliberate non-test detonation before 2030. The blue and orange dots show the baseline forecasts, and the tips of the arrows show the forecast conditional on the event. Yellow dots indicate forecasts that would not change conditional on the event. The y-axis uses a logarithmic scale to informatively show variation in forecasts in the 0–10% range.*

Non-test detonation event by 2030	Expert Median (IQR)			Superforecaster Median (IQR)		
	N*	Relative risk	Probability of occurring	N*	Relative risk	Probability of occurring
Deliberate	87	4x (1.5x - 31.3x)	1.0% (0.1% - 10%)	37	6.7x (1.65x - 16.7x)	0.5% (0.1% - 2%)
Inadvertent	88	3x (1.3x - 18.5x)	1.3% (0.1% - 10%)	37	3x (1.5x - 10x)	0.1% (0.01% - 0.5%)
Accidental	87	1x (1x - 2x)	1.0% (0.01% - 10%)	37	1x (1x - 1.1x)	0.05% (0.01% - 0.3%)

Table 4: *Relative risk of nuclear catastrophe conditional on different types of non-test nuclear detonations occurring before 2030 and probability of this occurring. The median and interquartile ranges for experts and superforecasters are shown. *N is the number of responses for relative risk. 110 experts and 39 superforecasters provided forecasts on the probability of the events occurring.*

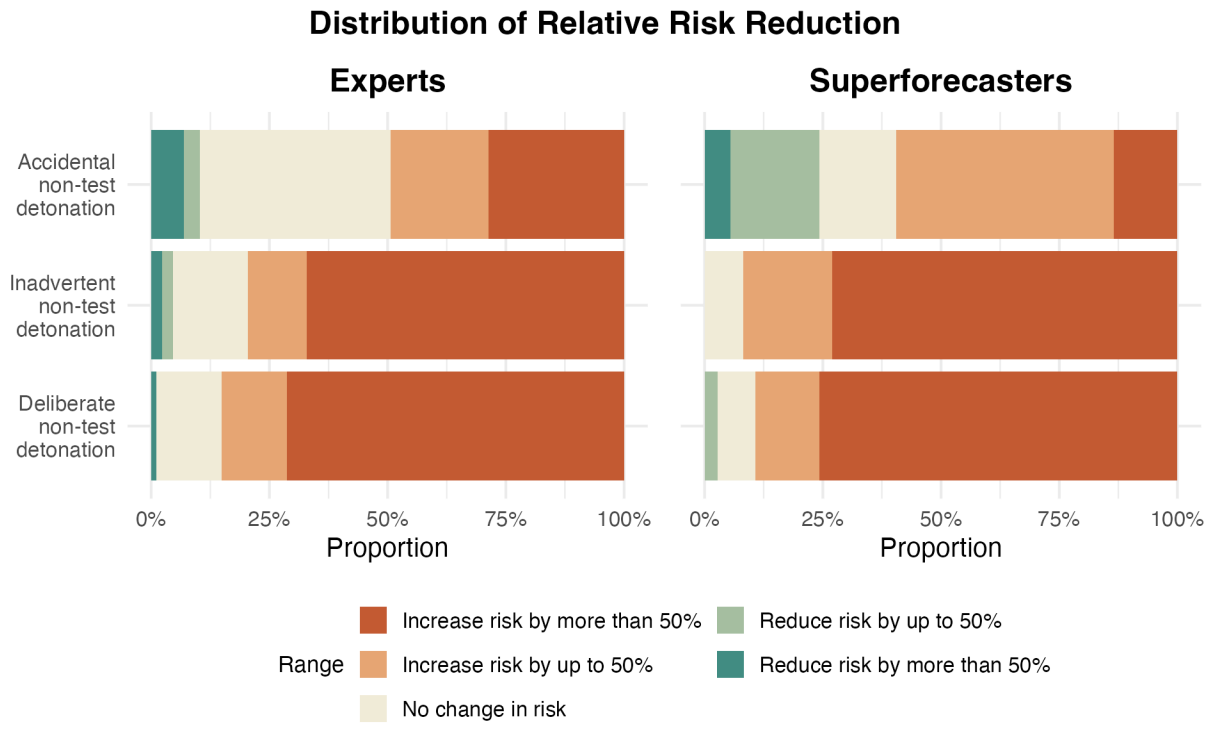

Figure 14: *Plot shows the proportion of respondents who would increase, decrease, or not change their forecast of nuclear catastrophe, if they knew that different types of non-test detonations would occur by 2030.*

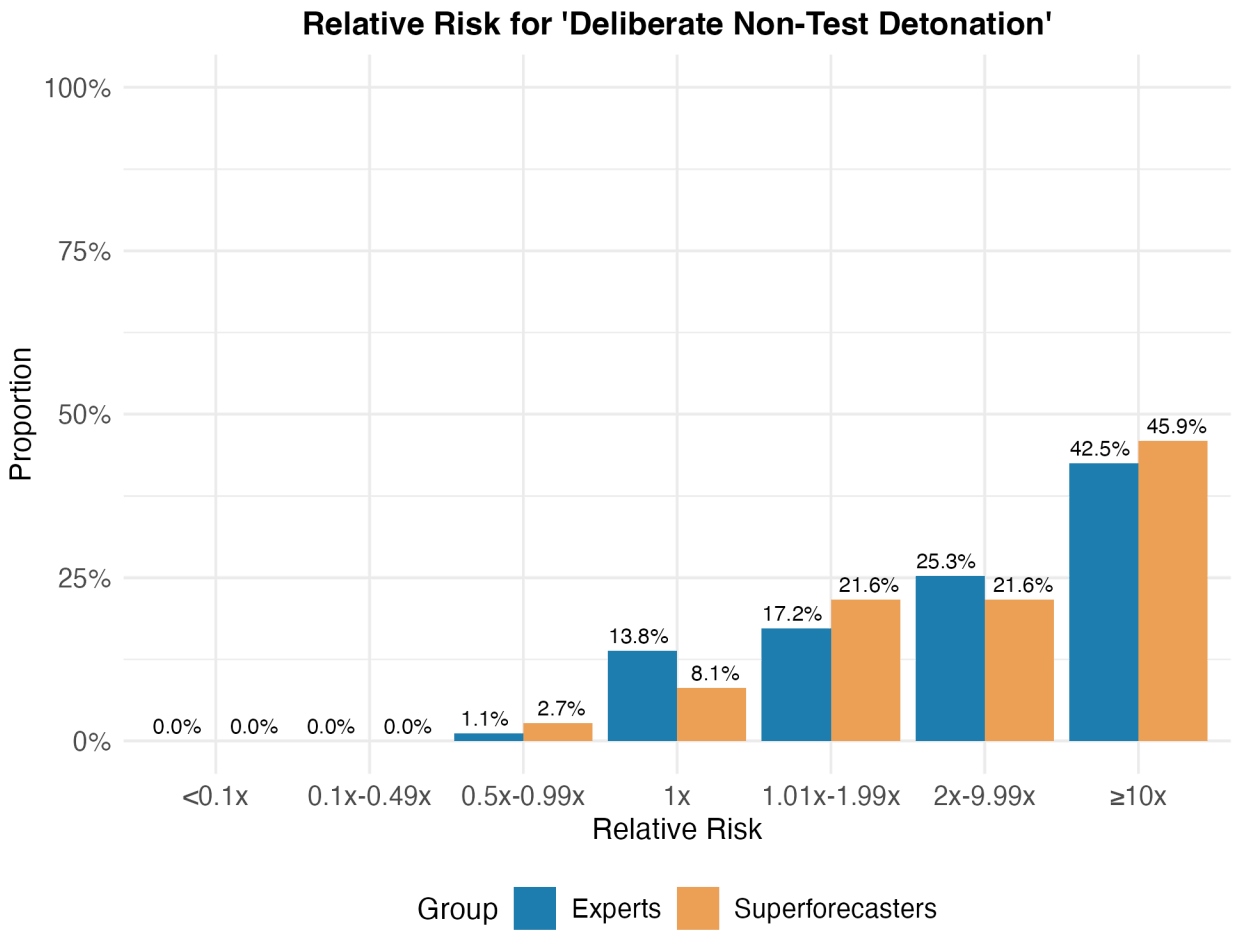

Figure 15: *Plot shows the proportion of respondents whose relative risk (relative change in risk of nuclear catastrophe) for a deliberate non-test detonation falls into each of the ranges.*

Perhaps more surprisingly, participants were split on the effects of an accidental non-test detonation on the risk of nuclear catastrophe. Figures 16 and 17 show how forecasts would change if this were to occur. Around 60% of superforecasters and 49% of experts would increase their probability of a nuclear catastrophe, but roughly 15% of participants would decrease their forecast. In rationales, those who decreased their forecast suggested that an accidental nuclear detonation could serve as a wake-up call that prompts greater action to reduce nuclear weapons risk. (For more detail on arguments, see Appendix 9.)

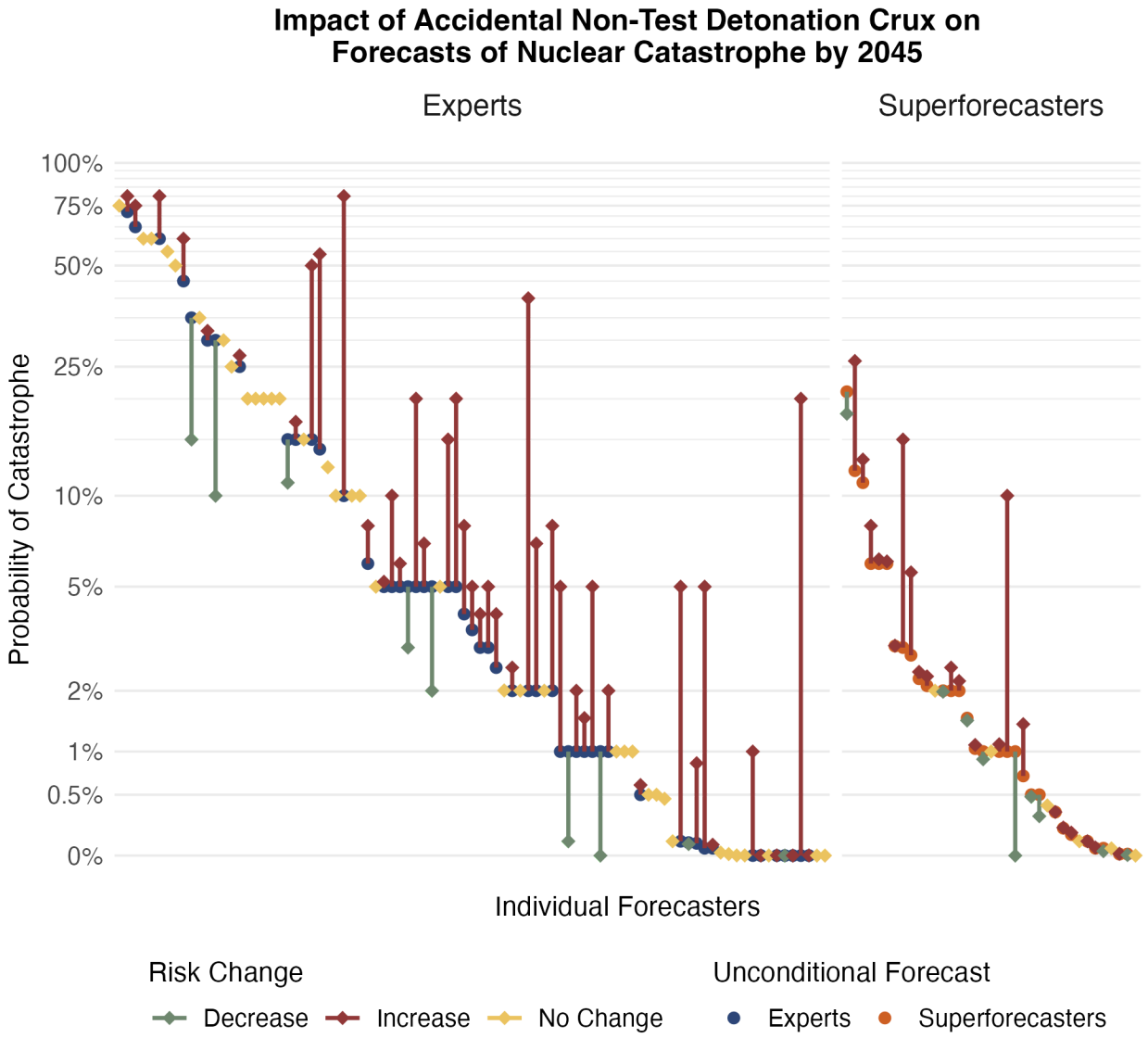

Figure 16: *Plot shows how individual respondents' forecasts of nuclear catastrophe would change conditional on an accidental non-test detonation before 2030. The blue and orange dots show the baseline forecasts, and the tips of the arrows show the forecast conditional on the event. Yellow dots indicate forecasts that would not change conditional on the event. The y-axis uses a logarithmic scale to informatively show variation in forecasts in the 0–10% range.*

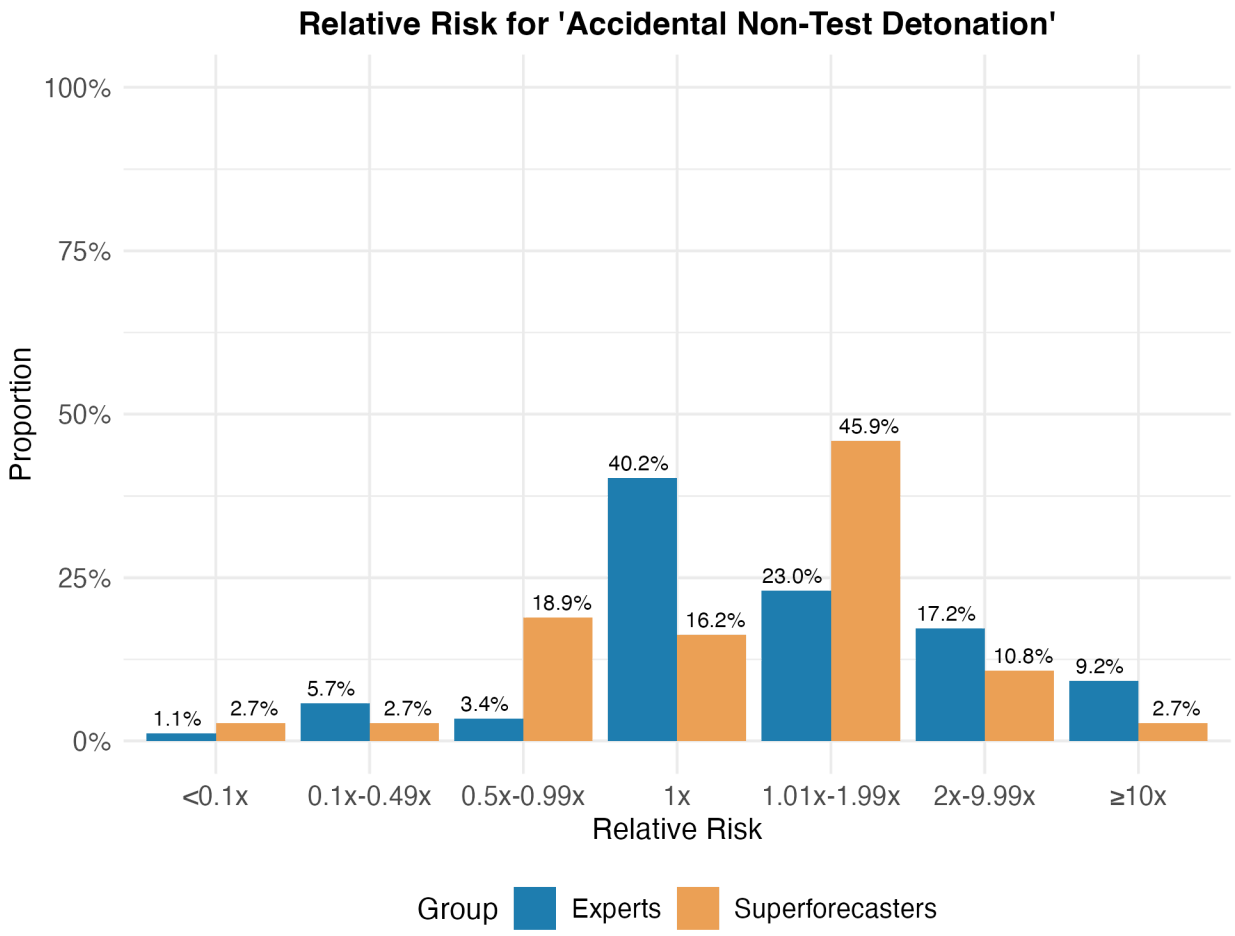

Figure 17: *Plot shows the proportion of respondents whose relative risk (relative change in risk of nuclear catastrophe) for an accidental non-test detonation falls into each of the ranges.*

Most participants thought the probability of any type of non-test nuclear detonation before 2030 was quite low. The median expert forecasted a 1% chance of a deliberate non-test detonation occurring and a 1.3% chance of an inadvertent non-test detonation occurring. The median superforecaster thought these events were even less likely, forecasting 0.5% and 0.1% probabilities for deliberate and inadvertent non-test detonations occurring, respectively. Superforecasters also thought the probability of an accidental non-test detonation was very low, with a median probability of 0.05%. The median expert put the probability of an accidental detonation at 1%. Table 4 summarizes these results and views on the relative change in risk conditional on different types of detonations.

4.3.2 Key factors influencing risk: conflict and horizontal proliferation

The other events driving higher forecasts of nuclear catastrophe either involved conflict with nuclear-armed countries or the spread of nuclear weapons to new actors (horizontal proliferation).

In particular, participants believed conflict between Russia and NATO would increase risk. We asked about both conflict between Russia and the USA and conflict between Russia and a NATO member other than the USA. Conditional on conflict between Russia and the USA, the median participant of both groups would roughly triple their forecast of the risk of nuclear catastrophe. The median expert forecast a 5% probability of such conflict occurring before 2030, and the median superforecaster 1.8%. Both groups thought that conflict between Russia and a NATO member other than the USA was more likely. The median expert forecast a 10% chance of this happening before 2030, and the median superforecaster a 5.5% chance. The median expert thought this would triple the risk of nuclear catastrophe by 2045, and the median superforecaster that it would roughly double it.

Participants thought the probability of a Chinese invasion of Taiwan was more likely than other types of conflict, with the median expert forecasting a 25% probability of this happening before 2030, and the median superforecaster 19%. A Chinese invasion of Taiwan was also associated with a substantial increase in the probability of nuclear catastrophe, increasing by roughly 2.3 times for the median expert and roughly doubling for the median superforecaster.

The median expert also thought there was a 20% chance of violent conflict between India and Pakistan before 2030, which they thought would increase the risk by around 40%. Superforecasters were more skeptical of both the probability of this event occurring (median of 6.5%) and its importance for nuclear risk (with a median relative risk of 1, indicating no change in risk).

Event by 2030	Expert Median (IQR)			Superforecaster Median (IQR)		
	N	Relative risk	Probability of occurring	N	Relative risk	Probability of occurring
500 militarized deaths between Russia and the USA	50	3.1x (1.5–11.8x)	5% (1–10%)	36	2.8x (1.5–12.5x)	1.8% (0.6–5%)
500 militarized deaths between Russia and a different NATO country	50	3x (1.3–7.5x)	10% (2.8–32.5%)	36	1.9x (1.2–3.2x)	5.5% (1.2–15%)
China invades Taiwan	36	2.3x (1–5.5x)	25% (10–45%)	11	1.9x (1.3–3.6x)	19% (4–31.5%)
500 militarized deaths between North Korea and USA	48	1.7x (1– 5x)	4% (1–12.5%)	15	2x (1.4–9x)	2% (1– 4%)
500 militarized deaths between China and the USA	36	1.8x (1–5x)	10% (1.3–30%)	11	2x (1.2–3.4x)	6% (2.8–14%)
500 militarized deaths between North Korea and South Korea	49	1.6x (1–5x)	8% (4.5–21.3%)	15	1.4x (1.1–3x)	3.3% (2–5.3%)
500 militarized deaths between India and Pakistan	42	1.4x (1–3.5x)	20% (5–50%)	14	1x (1–1.1x)	6.5% (3.5–22.8%)

Table 5: *Relative risk of nuclear catastrophe conditional on different types of violent conflict occurring before 2030 and probability of event occurring by 2030. *N is the number of responses for relative risk. 110 experts provided forecasts on the probability of the events occurring.*

The median expert thought that non-state actors acquiring nuclear weapons would double the probability of nuclear catastrophe. The median expert forecast a 1% probability of this occurring by 2030, and the median superforecaster a 0.3% probability. Both groups thought it more likely that Iran would acquire a nuclear weapon (with median forecasts of 25% and 30% for experts and superforecasters, respectively). The median expert's forecast of nuclear catastrophe would increase by roughly 50% if this were to occur, and the median superforecaster's by approximately 20%. For a more detailed discussion of the rationales participants gave for their responses to these crux questions, please see Appendix 10.

Event by 2030	Expert Median (IQR)			Superforecaster Median (IQR)		
	N*	Relative risk	Probability of occurring	N	Relative risk	Probability of occurring
A non-state actor acquires nuclear weapons	88	2x (1.2–10x)	1% (0.002–5%)	39	1.8x (1–5x)	0.3% (0.1–1.4%)
Iran acquires nuclear weapons	88	1.5x (1.1–3x)	25% (15–50%)	39	1.2x (1.1–1.5x)	30% (10– 50%)
Any state other than Iran acquires nuclear weapons	89	1.3x (1–2.4x)	1% (0.3–10%)	39	1.2x (1.1–1.7x)	5% (1–10%)

Table 6: *Relative risk of nuclear catastrophe conditional on different actors acquiring nuclear weapons before 2030 and probability of this occurring. The median and interquartile ranges for experts and superforecasters are shown. *N is the number of responses for relative risk. 110 experts provided forecasts on the probability of the events occurring.*

Several other cruxes (including the USA withdrawing from NATO or ROKUS, increasing entanglement of nuclear and non-nuclear forces, vertical proliferation, and states other than North Korea conducting weapons tests) were also associated with smaller increases in the risk of nuclear catastrophe. For more detail, see Appendix 11.

4.3.3 Factors that generally did not influence forecasts

Perhaps the most striking finding is that many of the participants wouldn't change their forecast of nuclear risk if many of the cruxes were to occur. As discussed earlier, these cruxes included an accidental non-test detonation. They also included whether nuclear-armed states do or do not have no-first-use policies. Figure 18 shows how participants' forecasts of nuclear catastrophe changed conditional on the USA having a no-first-use policy by 2030. Most participants thought that this wouldn't affect risk at all. Some thought it would reduce risk, and a smaller number thought it would increase risk.

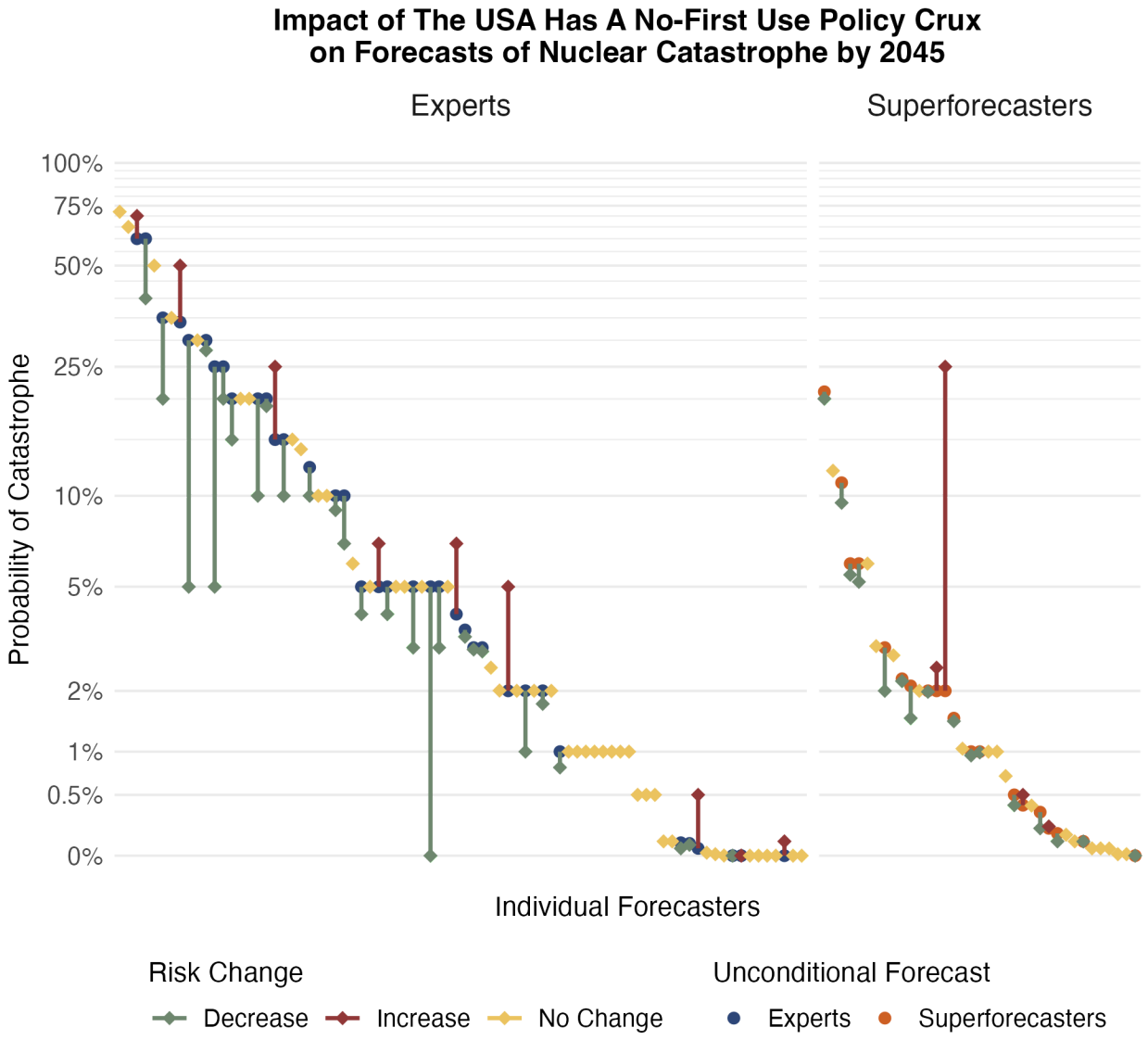

Figure 18: *Plot shows how individual respondents' forecasts of nuclear catastrophe would change conditional on the USA having a no-first-use policy before 2030. The blue and orange dots show the baseline forecasts, and the tips of the arrows show the forecast conditional on the event. Yellow dots indicate forecasts that would not change conditional on the event. The y-axis uses a logarithmic scale to informatively show variation in forecasts in the 0–10% range.*

Other potential cruxes that the median participant thought would not affect their forecast of catastrophe were:

- Summits between adversarial countries
- A terrorist attack in India that is blamed on Pakistan
- A nuclear weapons test by North Korea
- Ballistic missile submarines becoming more detectable
- The US rejoining JCPOA or a similar agreement

As with the USA having a no-first-use policy, many participants did think that these cruxes would influence the risk of nuclear catastrophe, although there wasn't consensus in which direction (see Figure 19). However, in most of these cases, a plurality of respondents thought that the event occurring would have no impact on the probability of nuclear catastrophe. Details on how participants responded to all of the cruxes are in Appendix 11.

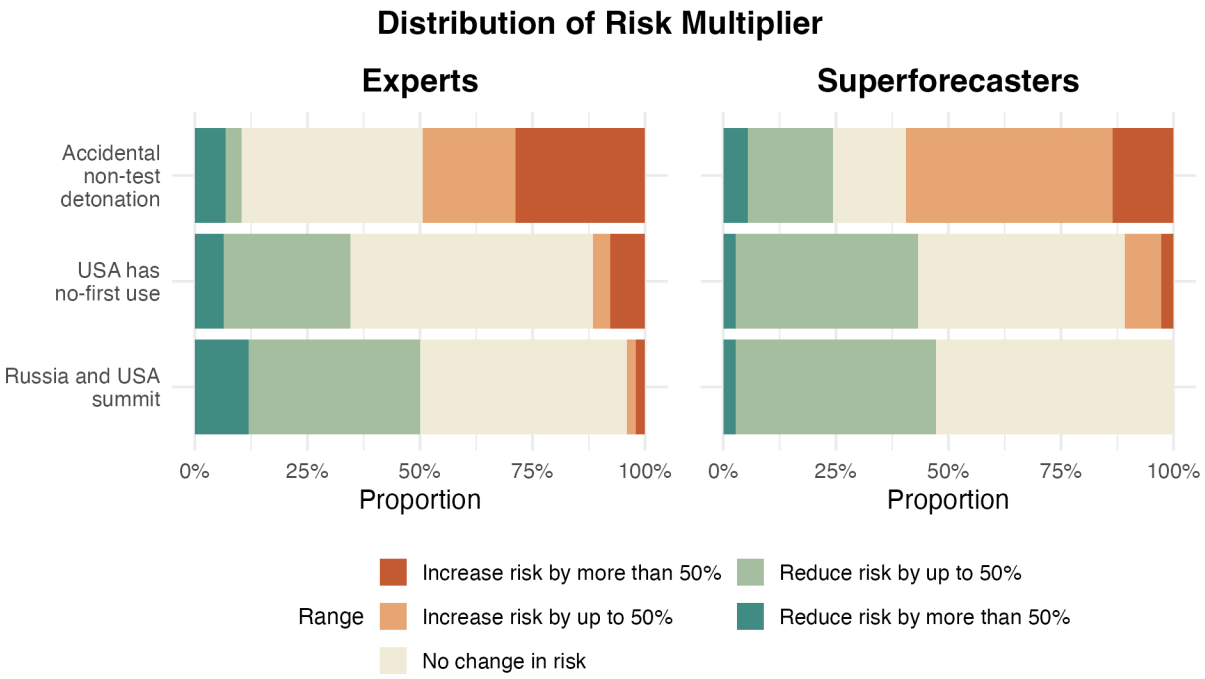

Figure 19: *Plot shows the proportion of respondents who would increase, decrease, or not change their forecast of nuclear catastrophe, if they knew that different events would occur by 2030. For each of the events in this plot, the median participant's relative risk was one, indicating the event would not change their forecast of nuclear catastrophe.*

5. Views on policies

Key points

- Of the policies we asked about, the two most popular amongst experts and superforecasters were:
  - A secure multilateral crisis communications center
  - All nuclear-armed states conducting failsafe reviews
- These two policies were thought to be the most effective in reducing the risk of a nuclear catastrophe, had the best average ranks, and had at least a 20% chance of being implemented, conditional on funding aimed at their implementation.
- If six policies were to be implemented, the median expert thought that the risk of nuclear catastrophe could be halved, and the median superforecaster thought it could be reduced by 40%.

We investigated views on 23 different policies that have been suggested as mechanisms to reduce the risk of nuclear catastrophe. We included six general policies (i.e., not specific to any adversarial domain) and 17 domain-specific policies. The full description of the policies is in Appendix 4.

As different domain-specific policies were answered by different participants, and the sample size for each of these domain-specific policies was relatively small, we advise caution in interpreting the domain-specific policy results and particularly in making comparisons across the adversarial domains. For this reason, we present the results of the general policies and the domain-specific policies separately.

5.1 General policies

5.1.1 Policy impact on risk of nuclear catastrophe

Most expert participants thought each of these six policies would reduce the risk of a nuclear catastrophe by between 9% and 25% relative to their unconditional forecast. In general, compared to experts, superforecasters thought policies would make less of a difference to nuclear risk. The median superforecaster thought most policies would reduce risk by between 3% and 15%. Figures 20 and 21 show how the median expert and median superforecaster's

estimate of the probability of nuclear catastrophe changes when considering each of these six policies. We also asked participants how their forecast of the probability of nuclear catastrophe would change if *all* of these six policies were implemented. Although this scenario is very unlikely to occur, it gives an indication of how nuclear risk could change if drastic actions were taken. The median participant thought these six policies implemented together could halve the probability of nuclear catastrophe by 2045. Table 7 shows the median participants' views on the effectiveness of the six general policies in terms of relative and absolute changes in risk.

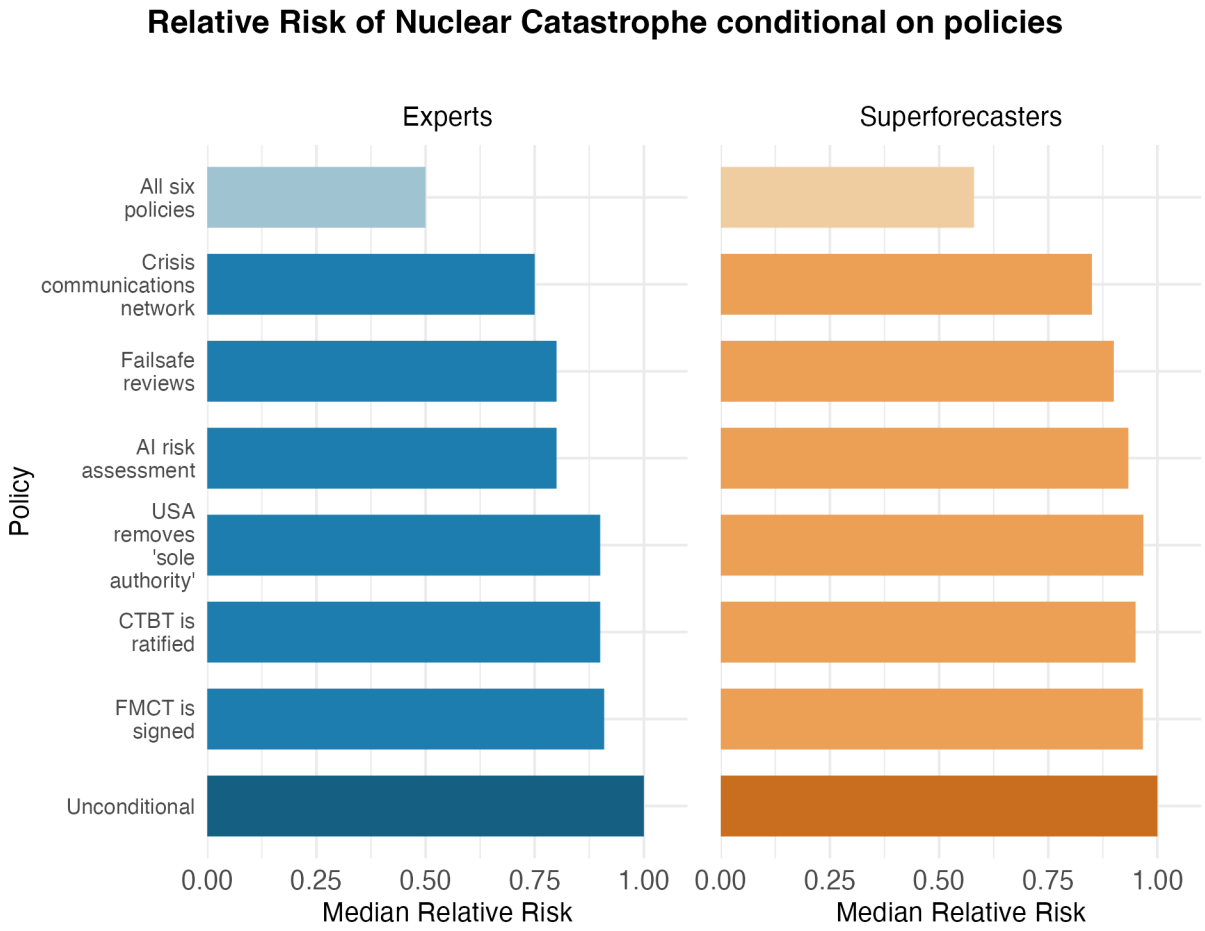

Figure 20: *Median relative change in probability of nuclear catastrophe conditional on policy implementation, for experts (blue) and superforecasters (orange). The difference between the height of the bar associated with the policy and the bar labeled "unconditional" represents relative reduction in risk of nuclear catastrophe associated with the policy by the median expert (left) and superforecaster (right). E.g., the median expert would reduce their forecast of nuclear catastrophe by 25% if a crisis communications network were to be established.*

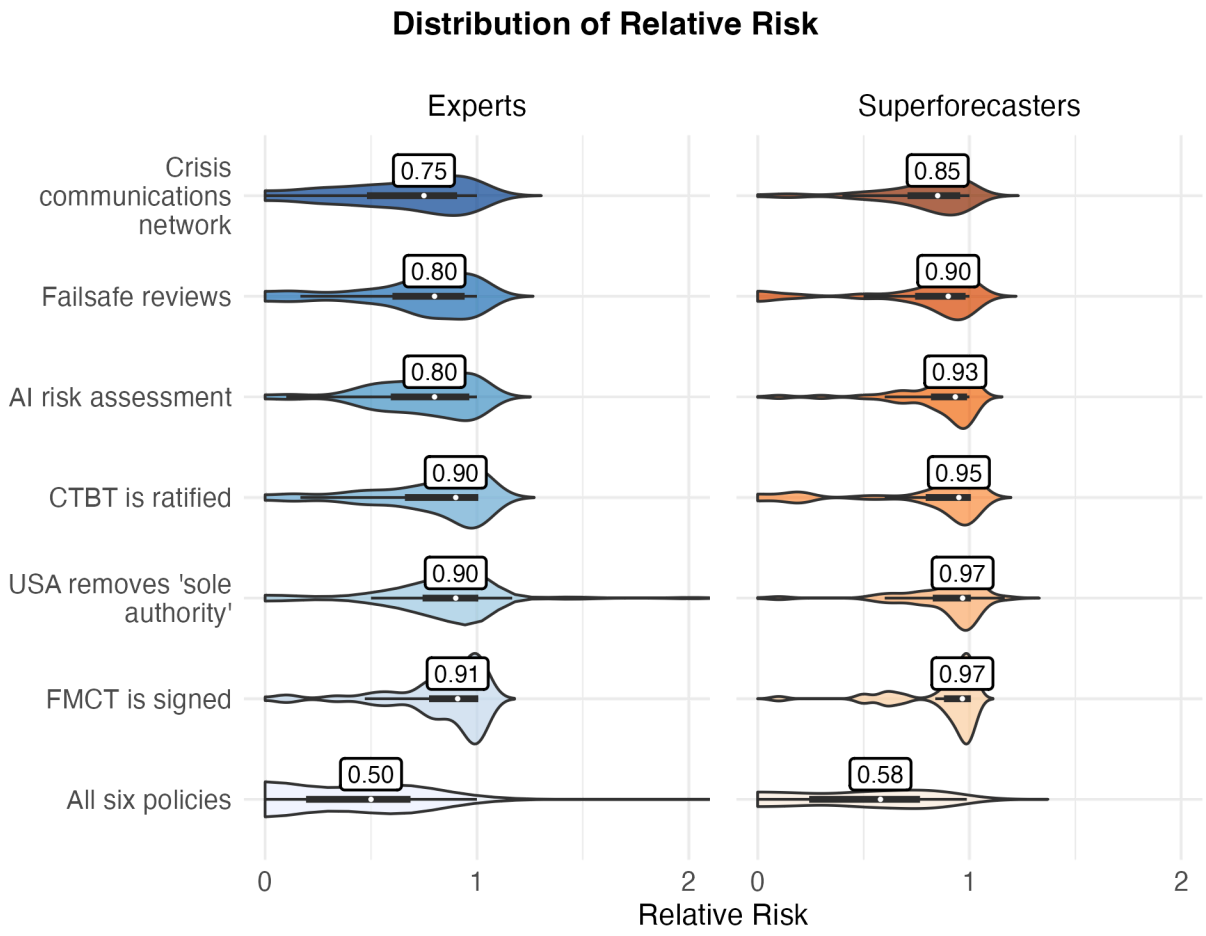

Figure 21: *Violin plots showing distribution of relative risk associated with each policy. The relative risk is the relative reduction in probability of nuclear catastrophe conditional on policy implementation. The group median relative risk is shown in text. The thicker bar within each violin shows the interquartile range (25th to 75th percentile forecasts), and the thin line shows the range of forecasts minus outliers.*

	Expert Median forecast (IQR)			Superforecaster Median forecast (IQR)		
Policy	**N***	**Relative change in risk**	**Absolute change in risk**	**N**	**Relative change in risk**	**Absolute change in risk**
AI risk assessment	94	0.8x (0.6–0.96x)	0.5pp (0–3pp)	37	0.93x (0.83–0.98x)	0.04pp (0.004–0.2pp)
Crisis communications network	96	0.75x (0.49–0.9x)	0.85pp (0.02–4.4pp)	37	0.85x (0.71–0.95x)	0.1pp (0.02–0.65pp)
CTBT is ratified	95	0.9x (0.67–1x)	0.05pp (0–3pp)	37	0.95x (0.8–1x)	0.01pp (0–0.25pp)
Failsafe reviews	96	0.8x (0.61–0.94x)	0.5pp (0–2pp)	37	0.9x (0.75–0.98x)	0.1pp (0.01–0.4pp)
FMCT is signed	95	0.91x (0.78–1x)	0.01pp (0–2pp)	37	0.97x (0.89–1x)	0.01pp (0–0.1pp)
USA removes ‘sole authority’	96	0.9x (0.75–1x)	0.1pp (0–1pp)	37	0.97x (0.83–1x)	0.02pp (0–0.13pp)
All six policies together	96	0.5x (0.2–0.69x)	2pp (0.18–5pp)	37	0.58x (0.25–0.76x)	0.3pp (0.09–1.5pp)

Table 7: *Views on effects of policies on probability of nuclear catastrophe. The median and interquartile range (25th percentile and 75th percentile estimates) are shown for the relative risk (or relative change in risk) and the absolute risk reduction (in percentage points (pp)). *The values in this column show the number of experts whose data was used in the relative risk summary statistics. The number for the absolute change in risk is higher by two (as two experts gave an unconditional forecast of catastrophe of zero).*

Some respondents thought that some of the policies would increase risk. Of the general policies we asked about, the USA removing its “sole authority” policy that allows the President to launch a nuclear weapon without approval from others was most often thought to increase risk. 8% of experts and 11% of superforecasters thought this policy would increase risk. Rationales from these respondents argued that the policy would compromise the USA’s ability to act quickly in times of crisis, and would reduce the credibility of US nuclear deterrence (see Appendix 12 for more detail). Several expert forecasters believed that all six policies being implemented would increase risk, as this would be a destabilizing change. Table 8 and Figure 22 show the proportion of respondents who thought that each policy would decrease, increase, or not affect risk.

	Expert				Superforecaster			
Policy	N	Decrease risk	Not affect risk	Increase risk	N	Decrease risk	Not affect risk	Increase risk
AI risk assessment	94	78%	22%	0%	37	86%	14%	0%
Crisis communications network	96	89%	11%	0%	37	95%	5%	0%
CTBT is ratified	95	61%	39%	0%	37	68%	32%	0%
Failsafe reviews	96	78%	22%	0%	37	95%	5%	0%
FMCT is signed	95	58%	42%	0%	37	65%	35%	0%
USA removes 'sole authority'	96	64%	28%	8%	37	62%	27%	11%
All six general policies	96	93%	4%	3%	37	100%	0%	0%

Table 8: *Proportion of respondents who thought the policy would decrease risk (relative risk < 1), not affect risk (relative risk = 1), and increase risk (relative risk > 1).*

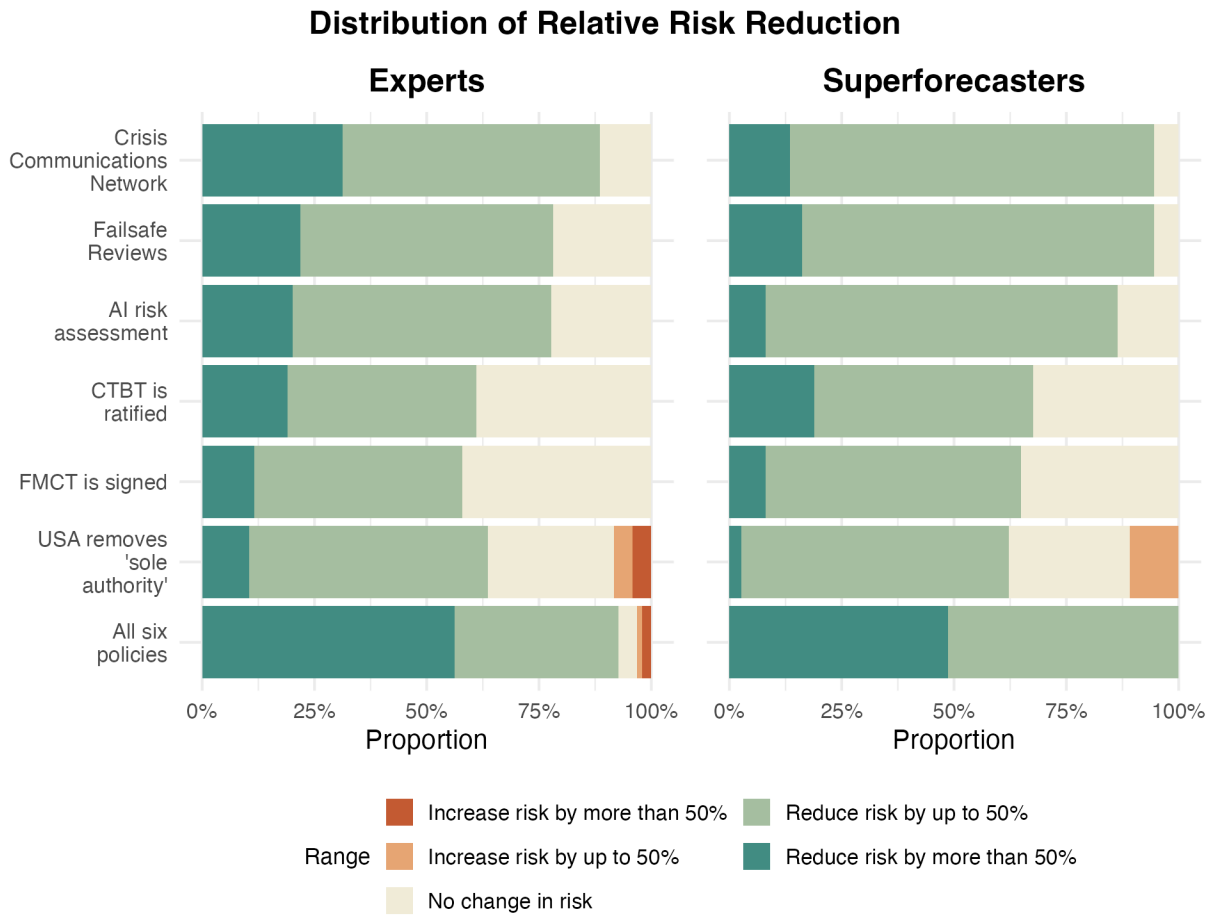

Figure 22: *Plot shows the proportion of respondents who would increase, decrease, or not change their forecast of nuclear catastrophe, conditional on policies being implemented.*

5.1.2 Probability of policy implementation and effects of funding

We asked participants to forecast the probability that each of these policies would be implemented. When participants were forecasting the effects of the policies, we asked them to make their forecast as if work to implement the policy would begin immediately. The description of each policy included a date by which implementation would be complete. When we asked participants to forecast the probability that the policy would be implemented, we pushed this date back by three years. So, we asked participants to forecast the probability that the policy would be implemented by three years later than the original date we described when asking participants to forecast the effects of policies. We asked for an unconditional forecast and a forecast conditional on a nonprofit team being given $500 million with the goal of getting the policy implemented. Table 9 and Figure 23 summarize these results.

	Expert Median (IQR)				**Superforecaster** Median (IQR)			
Policy	**N**	**Probability implemented**		**Funding multiplier**	**N**	**Probability implemented**		**Funding multiplier**
		Baseline	**With funding**			**Baseline**	**With funding**	
AI risk assessment	102	20% (10–40%)	30% (10–53.8%)	1.5x (1.1–1.9x)	39	9% (3–21.5%)	12% (4–31.5%)	1.3x (1.1–1.5x)
Crisis comms. network	104	15% (5–30%)	25% (10–50%)	1.4x (1.1–1.8x)	39	10% (4–25%)	18% (6–36.5%)	1.3x (1.1–2x)
CTBT is ratified	97	6.5% (1–15%)	10% (2.6–28.8%)	1.3x (1–2x)	36	5% (1–9.5%)	7% (2–10%)	1.1x (1–1.4x)
Failsafe reviews	103	15% (10–30%)	30% (15–50%)	1.5x (1.2–2x)	38	7% (3.5–16%)	10% (5.1–23%)	1.4x (1.1–2x)
FMCT is signed	97	5% (1–10%)	6.5% (2–15.8%)	1.2x (1–1.8x)	38	5% (1–13.5%)	9% (2–15%)	1.1x (1–1.5x)
USA removes sole authority	98	10% (3–20%)	20% (6–35%)	1.5x (1.2–2x)	35	4% (0.5–10%)	5% (1–16.5%)	1.3x (1–1.9x)

Table 9: *Views on the probability of policies being implemented (with implementation on a time scale that suggests a decision to implement is made within the next three years). The table shows the unconditional forecast of policy implementation and the forecast conditional on $500 million of funding going to a nonprofit tasked with getting the policy implemented. The median and interquartile range (25th percentile and 75th percentile estimates) are shown for each value.*

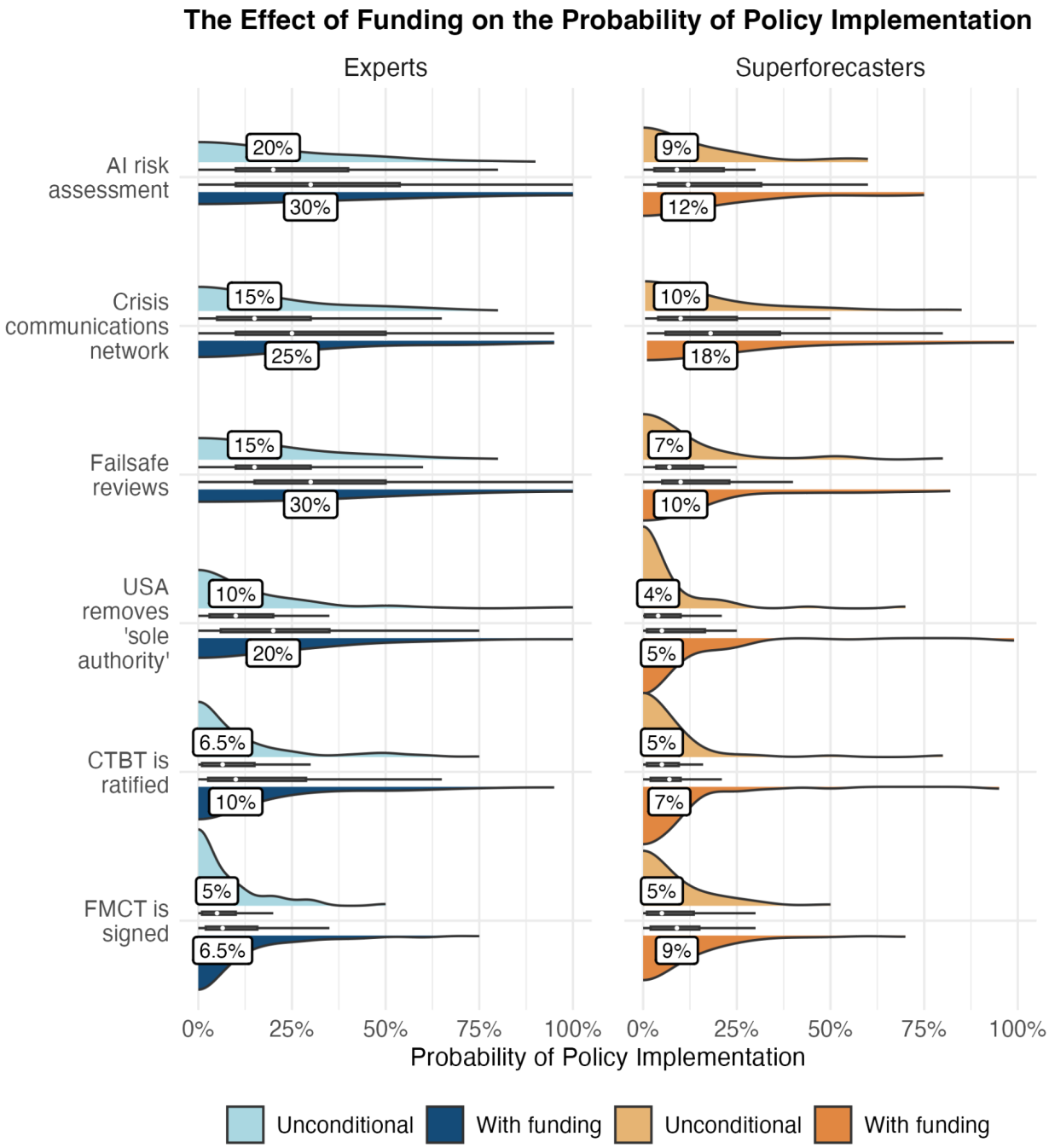

Figure 23: *Violin plots showing distribution of forecasts of the probability of policies being implemented, unconditionally (top) and conditional on $500 million in funding being provided to a non-profit group with the goal of getting the policy implemented (bottom). The thick line next to each violin shows the interquartile range (25th to 75th percentile forecasts), the thin line shows the range of forecasts minus outliers, and the text shows the median forecast.*

Beliefs about the probability that these policies would be implemented vary widely, both among participants and among policies. However, the median expert thought that, for the three policies believed to be most effective in reducing risk (crisis communications, failsafe reviews, and AI risk), there was at least a 15% chance of the policy being implemented. The median

superforecaster thought there was at least a 7% probability that these policies are implemented. Both groups thought that funding could make a meaningful difference to the probability a policy is implemented. The median expert thought the probability could increase by 20-50% depending on the policy, and the median superforecaster thought it could increase by 11-41%.

5.1.3 Policy ranking

We asked participants to rank the policies they were shown in two ways: first, by how much they would like the policy to be implemented, and second, by how much they would like $500 million to go to a hypothetical nonprofit aiming to have the policy implemented. When ranking for funding, participants were asked to consider the effects of the policy, probability the policy would be implemented, and the difference funding would make.

Table 10 shows the average rank and the proportion of participants who ranked each policy within the top three, for implementation and for funding. These values include the domain-specific policies in the ranks (rank is out of nine).

	Experts (N = 109)				**Superforecasters** (N = 39)			
	Average rank		**Rank in top 3**		**Average rank**		**Rank in top 3**	
Policy	To implement	For funding	To implement	For funding	To implement	For funding	To implement	For funding
AI risk assessment	4.6	3.6	39%	52%	4.7	3.9	33%	46%
Crisis comms. network	3.3	2.9	58%	70%	3.0	2.4	62%	77%
CTBT is ratified	4.3	4.7	41%	28%	4.7	4.8	33%	26%
Failsafe reviews	3.8	3.5	50%	61%	3.7	3.3	51%	62%
FMCT is signed	5.2	5.7	28%	17%	4.9	4.9	31%	18%
USA removes sole authority	6.7	6.3	13%	11%	6.0	6.4	28%	18%

Table 10: *Results of ranking exercises. Participants were asked to rank the policies in two ways: by how much they would like the policy to be implemented and by how much they would like $500 million in funding to go to a nonprofit that had the goal of getting the policy implemented. For both types of ranking we show the average rank for experts and superforecasters and the proportion of each group who ranked the policy within the top 3.*

Figures 24 and 25 show experts' and superforecasters' ranking of the six general policies by how much participants would like to see funding go towards having the policy implemented. Ranks closer to one indicate a stronger preference for that policy relative to others. Participants also ranked the three domain-specific policies they answered questions on. The ranks shown in Figures 24 and 25 exclude those domain-specific policies (and so ranks are shown out of six).

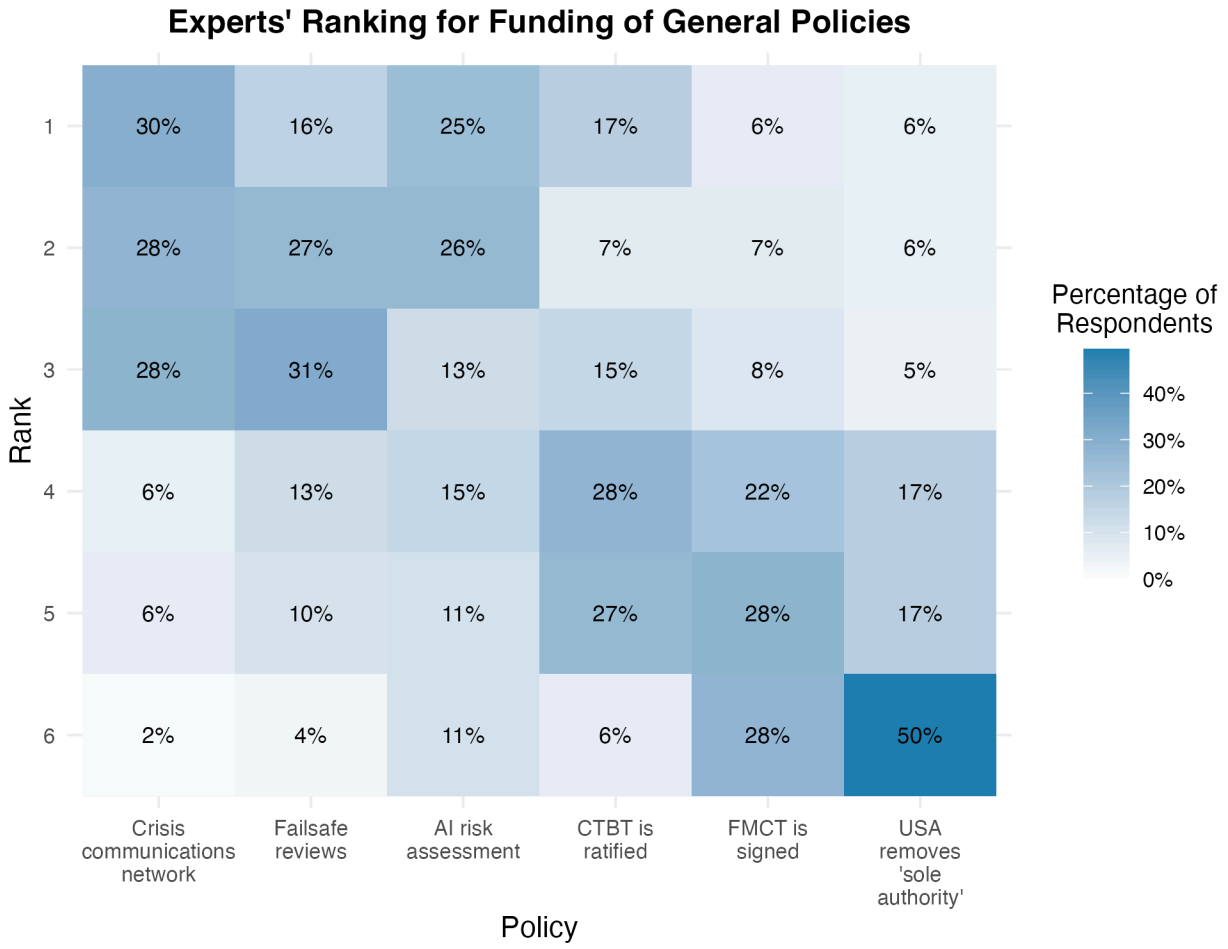

Figure 24: *Experts' ranking of the six general policies when considering where they would like $500 million funding to go to a nonprofit group who has the goal of getting the policy implemented. These are listed in order of average rank (most favored to least favored). The values inside the squares show the proportion of expert respondents who gave the policy that rank out of the six general policies.*

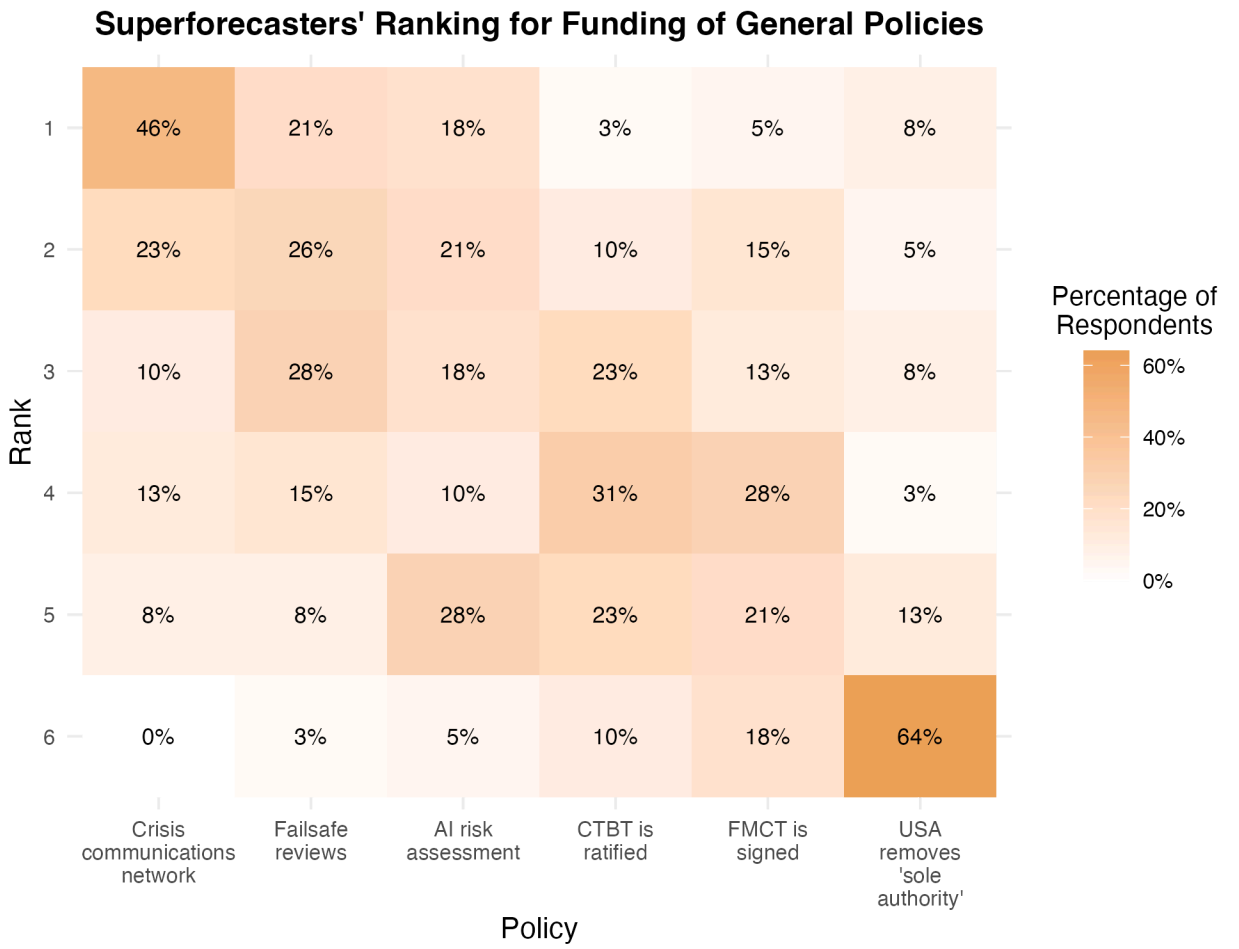

Figure 25: *Superforecasters' ranking of the six general policies when considering where they would like $500 million funding to go to a nonprofit group who has the goal of getting the policy implemented. These are listed in order of average rank (most favored to least favored). The values inside the squares show the proportion of expert respondents who gave the policy that rank out of the general policies.*

5.2 The two most popular policies

Of the six general policies, two were clearly favored by both groups of participants: establishing a crisis communications network, and all nuclear-armed countries conducting failsafe reviews. These policies were generally seen as more effective in reducing risk and more likely to be implemented than others. These policies were ranked within the top three by more than half of all participants. When asked about which policies they'd prefer to see funding go towards, these two policies were ranked within the top three by at least 60% of participants in both groups.

5.2.1 Crisis communications network

This policy would see a secure multilateral crisis communications network established with all nuclear-armed states participating. The full details of the policy (as it was described to

participants) is available in Appendix 4. In summary, the policy would see that a secure multilateral crisis communication network (such as the proposed CATALINK network[38]) is established. The network would be encrypted and robust to threats, and would allow for direct leader-to-leader communication, with the ability to conduct bilateral or multilateral communications. All nuclear-armed states would be actively participating in the network. This policy would build on existing "hotlines" between adversaries by providing a more secure connection that was more actively maintained and allowed for multilateral communications.

Effect of policy

This policy was associated with the largest relative risk reduction for both the median expert and the median superforecaster. Figure 26 shows the distribution of relative risk reduction attributed to this policy. It shows that roughly 80% of superforecasters and 60% of experts thought that this policy would reduce risk by up to 50%. Figure 27 shows how each individual participants' forecast would change conditional on the policy being implemented.

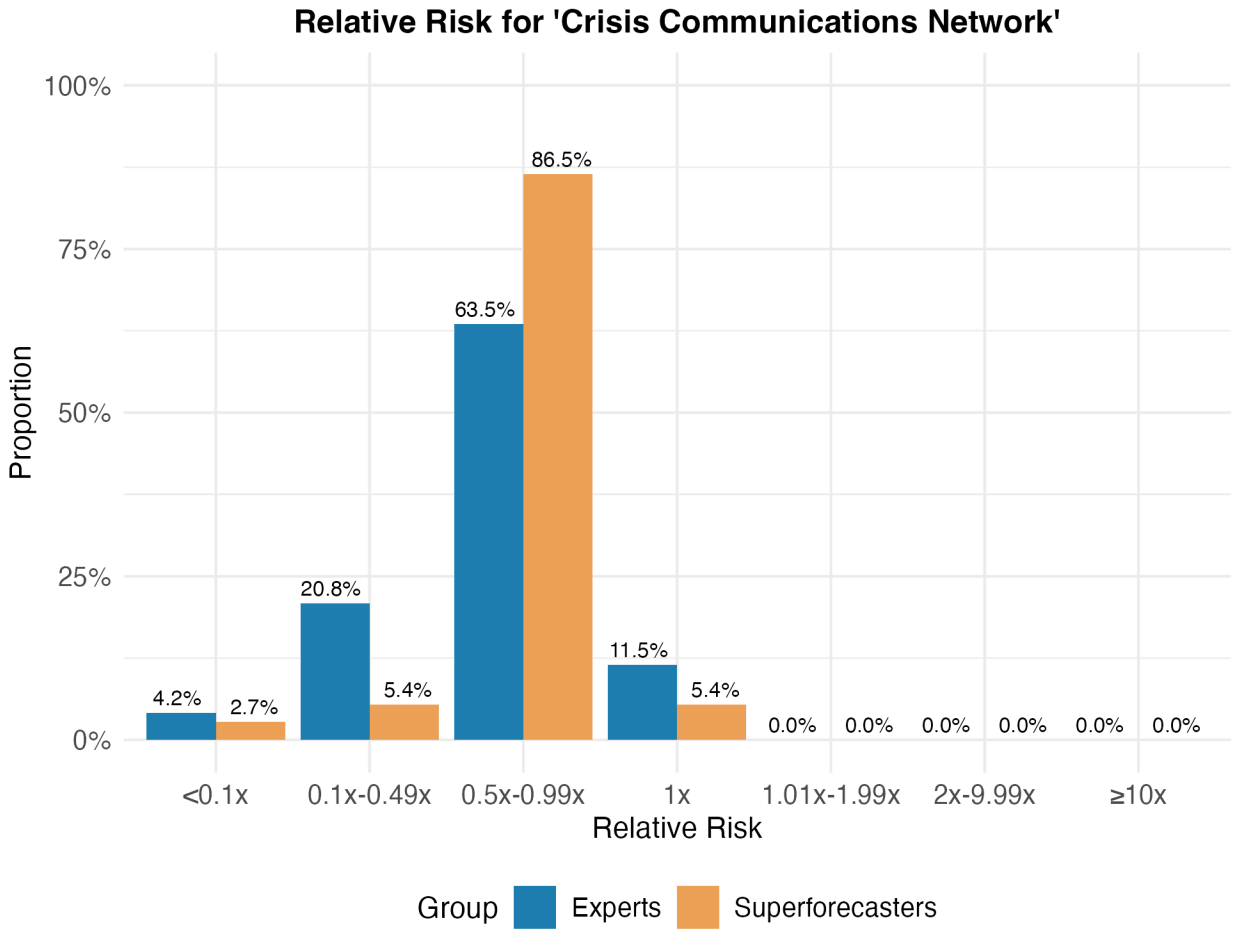

Figure 26: *Plot shows the proportion of respondents whose relative risk (relative change in risk of nuclear catastrophe) for the crisis communications network policy falls into each of the ranges.*

[38] "CATALINK," The Institute for Security and Technology, accessed October 17, 2024, https://securityandtechnology.org/catalink/.

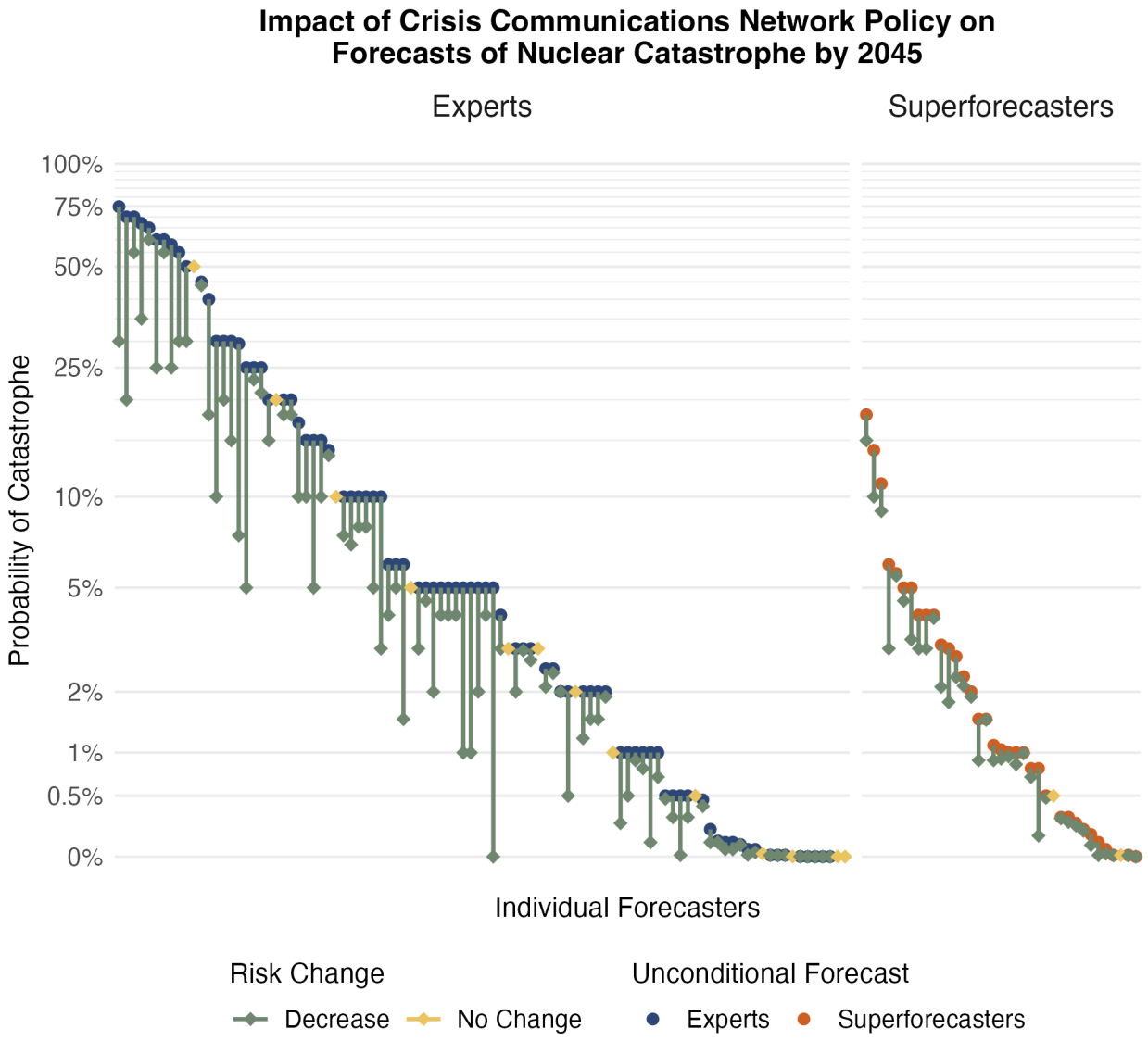

Figure 27: *Plot shows how individual respondents' forecasts of nuclear catastrophe would change conditional on a crisis communications network being established. The blue and orange dots show the baseline forecasts, and the tips of the arrows show the forecast conditional on the event. Yellow dots indicate forecasts that would not change conditional on the event. The y-axis uses a logarithmic scale to informatively show variation in forecasts in the 0–10% range.*

When explaining the rationales for their forecasts, participants who thought this policy would likely reduce risk substantially cited the importance of secure and prompt communication to prevent misunderstandings and the benefits of building trust and transparency between states. Many participants pointed to the Cuban Missile Crisis as an example of the importance of effective communication during crises. Participants who were less optimistic about the policy's effects suggested that some states may not use the network (as some states have not used bilateral hotlines), or may misuse it to spread misinformation or sow confusion. Some also noted

that this policy doesn't affect the underlying drivers of nuclear risk. For more details of arguments made in rationales, see Appendix 12.

Probability of policy implementation

The median superforecaster thought that, of the six general policies, a crisis communications network was the most likely to be implemented (with or without funding). They forecast a 10% probability of the policy being implemented, with that figure rising to 18% with dedicated funding. Experts were more optimistic about the chances of the policy being implemented, with a median unconditional forecast of 15%, which rose to 25% with funding. Figure 28 shows how forecasts of the probability of the policy being implemented change with funding.

Participants who gave higher forecasts for the probability of this policy being implemented suggested that this policy is a sensible and relatively easy step to take, especially as it builds on existing bilateral hotlines. Those who gave lower forecasts suggested that existing tensions would make cooperation difficult, especially as some states favor policies of strategic ambiguity. Some suggested that having *all* nuclear-armed states participate was a high bar.

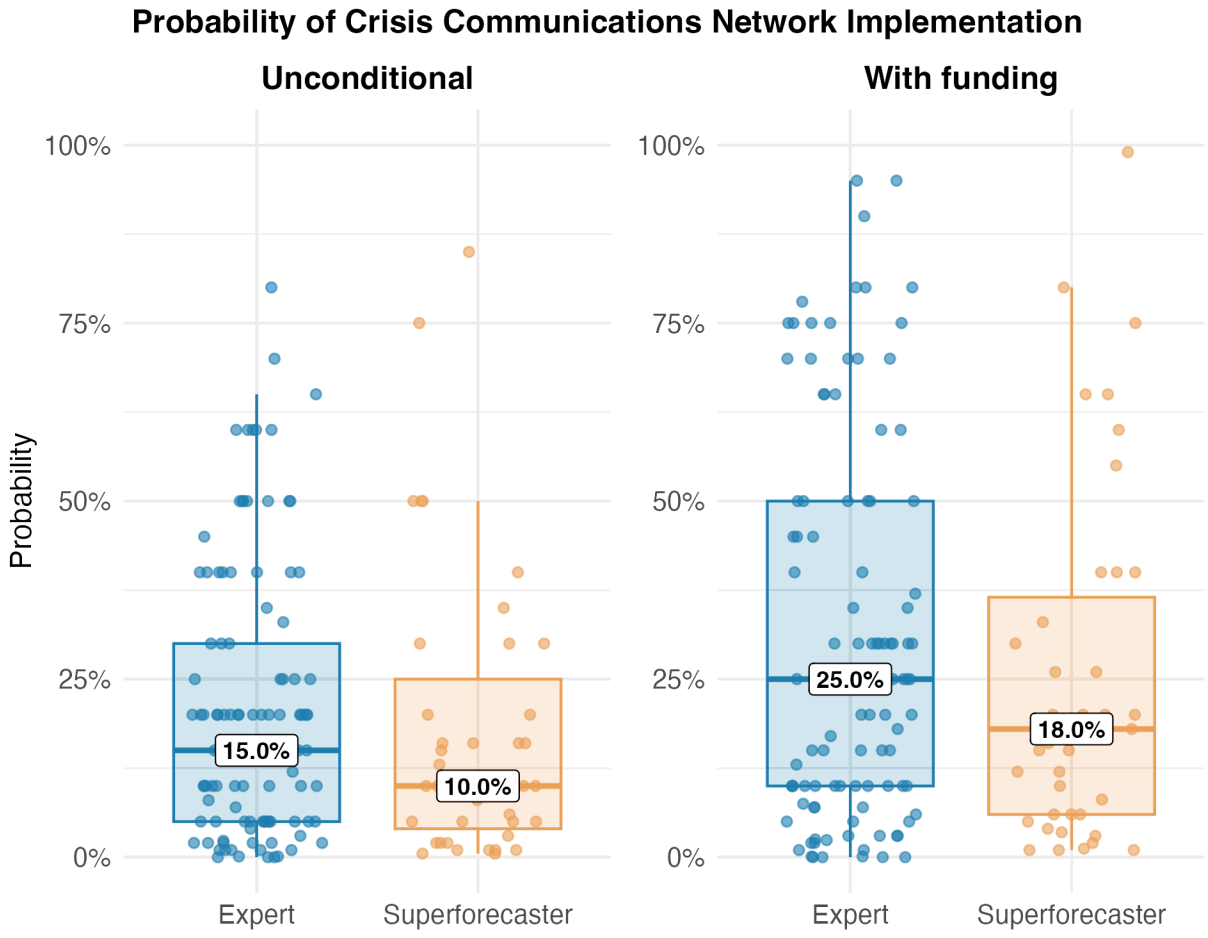

Figure 28: *Plots show forecasts of the probability of a crisis communications network being established, unconditionally and conditional on $500m funding going to a hypothetical nonprofit with the goal of getting*

the policy implemented. The median forecast is provided in text. The boxes show the 25th–75th percentile forecasts, and the lines the range of forecasts minus outliers. We jitter the data points horizontally to allow for better visualization of the distribution of forecasts. Horizontal variation within each group serves no other empirical purpose.

5.2.2 Failsafe reviews

This policy would see all national governments of nuclear-armed states establish a review mechanism to identify risks of inadvertent or accidental nuclear use and develop plans for mitigation of these risks. This would include, but is not limited to, false alarms, technical malfunctions, and human error. Each government would conduct an analysis to identify potential pathways to unintentional launches of nuclear weapons or false perceptions of being under attack, and would then consider areas of intervention to reduce the likelihood of these outcomes. The main focus should be on measures the government can take unilaterally to reduce risk from their systems. But if the reviews identify opportunities for risk mitigation that require multilateral action, these should be proposed to other nations' governments. This policy was loosely based on the "independent review of the safety, security, and reliability of U.S. nuclear weapons, NC3, and integrated tactical warning/attack assessment systems" announced in the US 2022 Nuclear Posture Review.[39] The description of this policy provided to respondents is available in Appendix 4.

Effect of policy

This policy was associated with the second largest relative risk reduction for both the median expert and the median superforecaster. Figure 29 shows how the distribution of forecasts on the probability of nuclear catastrophe shifts conditional on this policy being implemented. Figure 30 shows how each individual participants' forecast would change conditional on the policy being implemented.

[39] U.S. Department of Defense, "2022 National Defense Strategy of the United States of America," (U.S. Department of Defense, 2022). https://media.defense.gov/2022/Oct/27/2003103845/-1/-1/1/2022-NATIONAL-DEFENSE-STRATEGY-NPR-MDR.pdf.

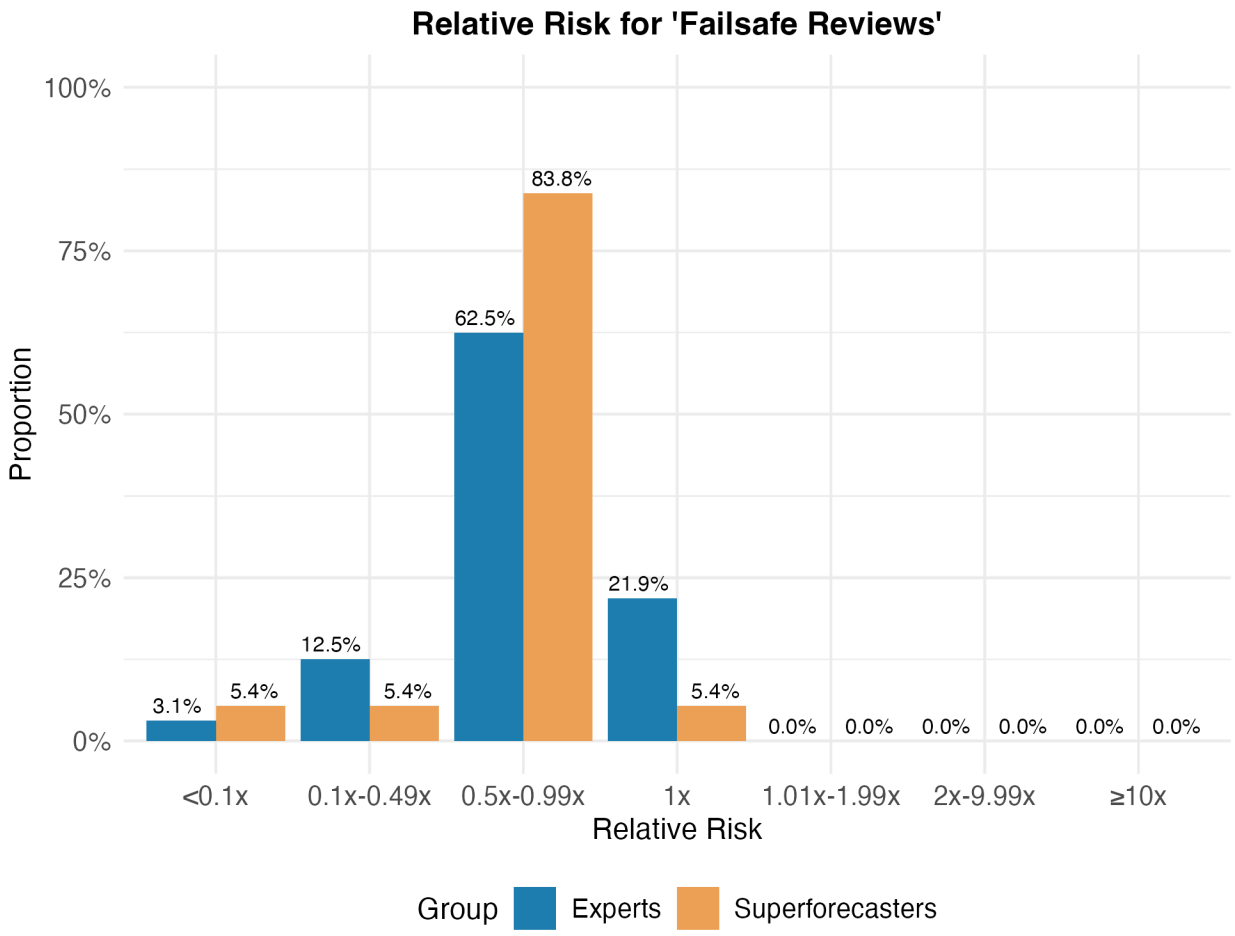

Figure 29: *Plot shows the proportion of respondents whose relative risk (relative change in risk of nuclear catastrophe) for the Failsafe Reviews policy falls into each of the ranges.*

Rationales for forecasts indicated that many participants thought that failsafe reviews could reduce the risk of accidental or inadvertent nuclear detonations and, by identifying ways to improve decision-making processes, reduce the risk of deliberate escalation during a crisis. Those who thought this policy would do little to reduce nuclear risk suggested that this policy primarily addresses accidental risks, which contribute little to nuclear risk, and do not affect risks of deliberate use. They also noted that nuclear-armed states regularly conduct their own reviews and that the quality of the reviews could vary between states. For more details of arguments made in rationales, see Appendix 12.

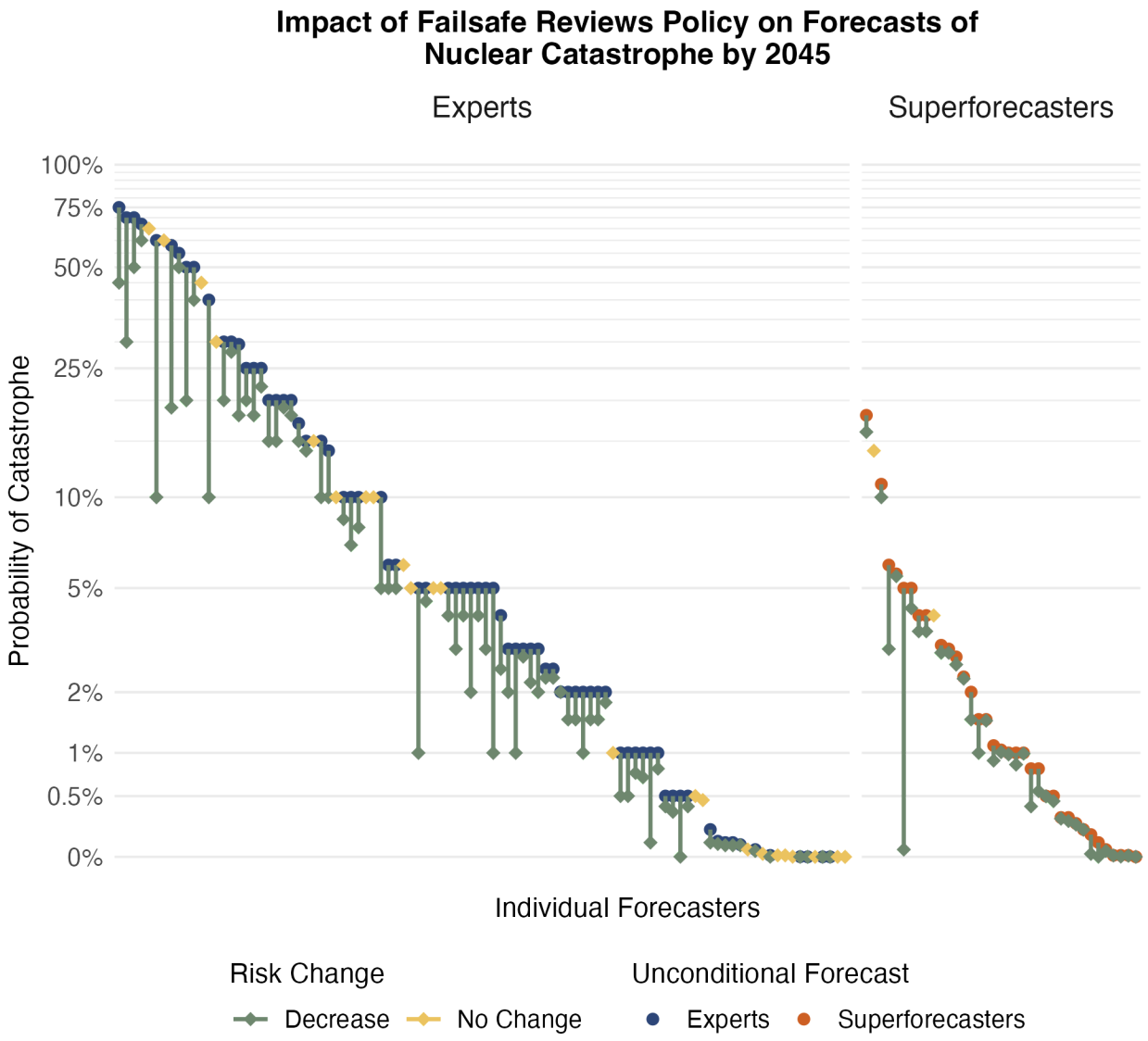

Figure 30: *Plot shows how individual respondents' forecasts of nuclear catastrophe would change conditional on the Failsafe Reviews policy being implemented before 2030. The blue and orange dots show the baseline forecasts, and the tips of the arrows show the forecast conditional on the event. Yellow dots indicate forecasts that would not change conditional on the event. The y-axis uses a logarithmic scale to informatively show variation in forecasts in the 0–10% range.*

Probability of policy implementation

The median expert forecasted a 15% probability of this policy being implemented, with this increasing to 30% with funding. Superforecasters forecasted a 7% probability unconditionally and a 10% probability with funding. Figure 31 shows how the distribution of forecasts of the probability of the policy being implemented changes with funding.

Those who were more optimistic about this policy being implemented suggested that this is a relatively uncontroversial policy that is low-risk and provides a way for states to demonstrate

responsibility. Many also suggested that wariness about cyber threats and the impact of AI might motivate states to conduct such a review. Those who were less optimistic suggested that countries like North Korea and Israel are unlikely to participate and that there is little incentive for states to agree to conduct a review.

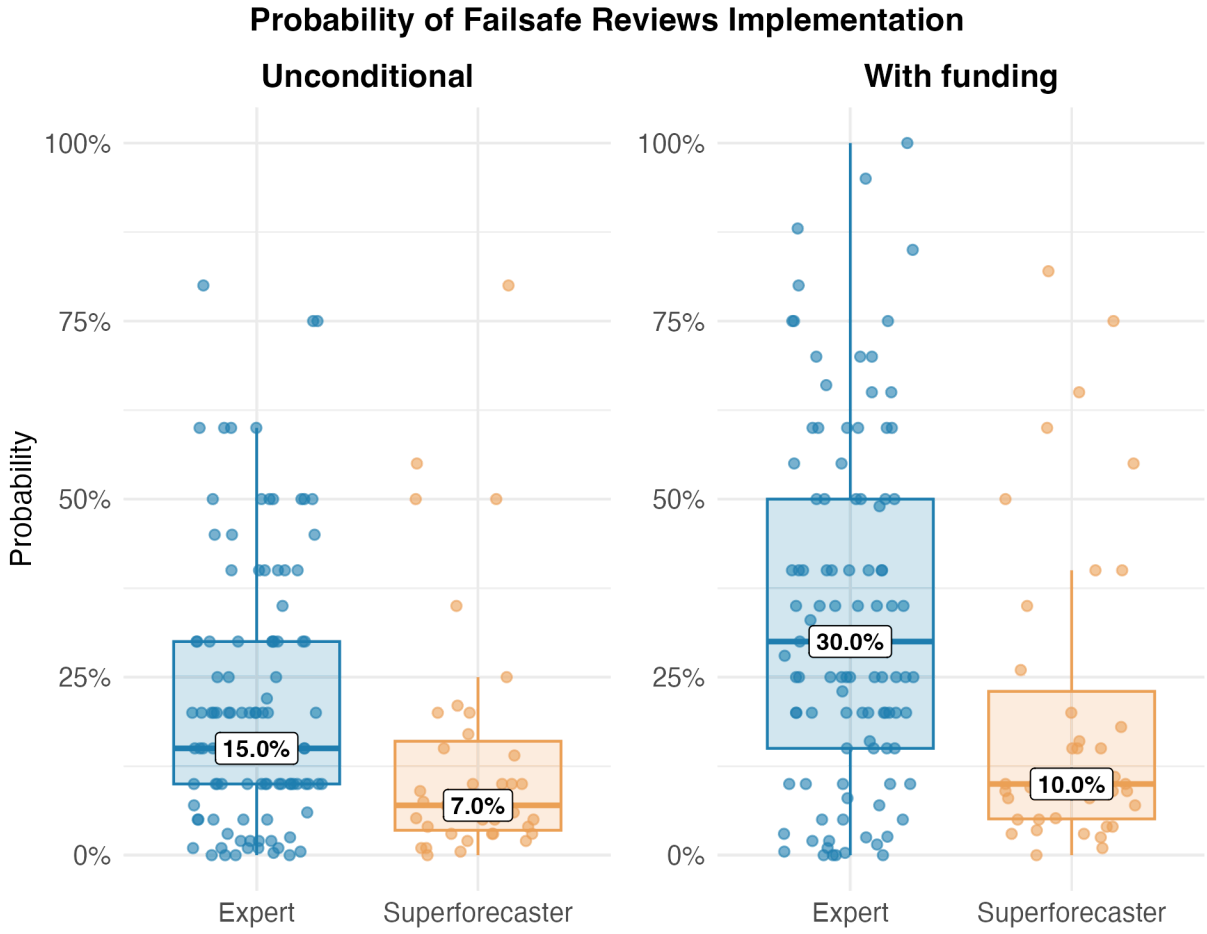

Figure 31: Plots show forecasts of the probability of the Failsafe Reviews policy being implemented, unconditionally and conditional on $500 funding going to a hypothetical nonprofit with the goal of getting the policy implemented. The median forecast is provided in text. The boxes show the 25th–75th percentile forecasts, and the lines the range of forecasts minus outliers. We jitter the data points horizontally to allow for better visualization of the distribution of forecasts. Horizontal variation within each group serves no other empirical purpose.

5.3 Domain-specific policies

As different domain-specific policy questions were answered by different participants, and the sample size for each of these domain-specific policies was relatively small, we advise caution in

interpreting these results, and particularly in making comparisons across the adversarial domains.

While noting the need for caution with these results, there are a few findings worth commenting on. Participants generally ranked domain-specific policies less favorably than general policies. The average rank for general policies was 4.6, and the average rank for domain-specific policies was 5.8 (when ranking for funding the values were 4.4 and 6.2). However, there were some exceptions to this.

Among the 25 experts who were shown the policy of Russia and the USA signing an arms control agreement similar to New START, the average rank was 3.5, slightly lower than the average rank for the failsafe review policy (3.8). The median expert thought this policy would reduce the probability of catastrophe by 20%, and that it had a 20% probability of being implemented, with this increasing to 25% with funding.

Among the 10 experts who answered on the China and the USA domain, the policy that would see the establishment of regular high-level dialogue between the USA and China was notably popular. The median expert in this group thought the policy would reduce the risk of nuclear catastrophe by 25% and had a 45% probability of being implemented (rising to 55% with additional funding). These experts gave it an average rank of 3.4 (or 4 when ranking for funding).

More detail on the rationales provided for forecasts relating to these two policies is available in Appendix 13. Domain-specific policy results are provided in more detail in Appendix 14 and quantitative forecasts from all policies are provided in Appendix 15. We also asked participants which policies they would have liked to see included in the survey. The responses are in Appendix 16.

6. Factors influencing forecasts

Key points

- Compared to experts, superforecasters generally gave lower forecasts for the probability of nuclear catastrophe and thought that policies would make less difference to the risk and were less likely to be implemented.
- There was no significant difference in forecasts of nuclear catastrophe for different age groups or, for experts, years of experience in the nuclear weapons field. However, experts who had more experience were more likely to be skeptical about the impacts of policies.
- Participants who were better at predicting the median expert forecast of catastrophe generally gave lower forecasts of catastrophe. However, participants who were better at predicting the median expert forecast of 2030 crux questions generally gave higher forecasts of catastrophe.

6.1 Demographics and expertise

As noted earlier, superforecaster participants put lower probabilities on nuclear catastrophe by 2045 than did subject matter experts. Their median forecast was 1%, compared to the median expert forecast of 5%.

Compared to superforecasters, experts also thought that policies would make a greater difference to the probability of nuclear catastrophe. To get a general indication of a participant's beliefs about how much of a difference policies could make, we took the average of the relative risks assigned to the general policies (i.e., not including the domain-specific policies), except for the policy that would see the USA relinquish the US President's sole authority to launch nuclear weapons (Sole Authority). Given that many participants thought this policy would increase risk, we excluded it from this calculation. When taking the average of the relative risk reduction for these five general policies, the median expert result is 0.75 (indicating a 25% reduction in risk), while the median superforecaster result is 0.82 (indicating an 18% reduction in risk).

There was no significant difference in forecasts of nuclear catastrophe for different age groups (including when superforecasters are excluded from the sample) or, for experts, years of experience in the nuclear weapons field (see figures 32 and 33). However, experts who had

more experience were more likely to be skeptical about the impacts of policies, with higher average relative risk for the general policies (excluding Sole Authority) (see Figure 33).

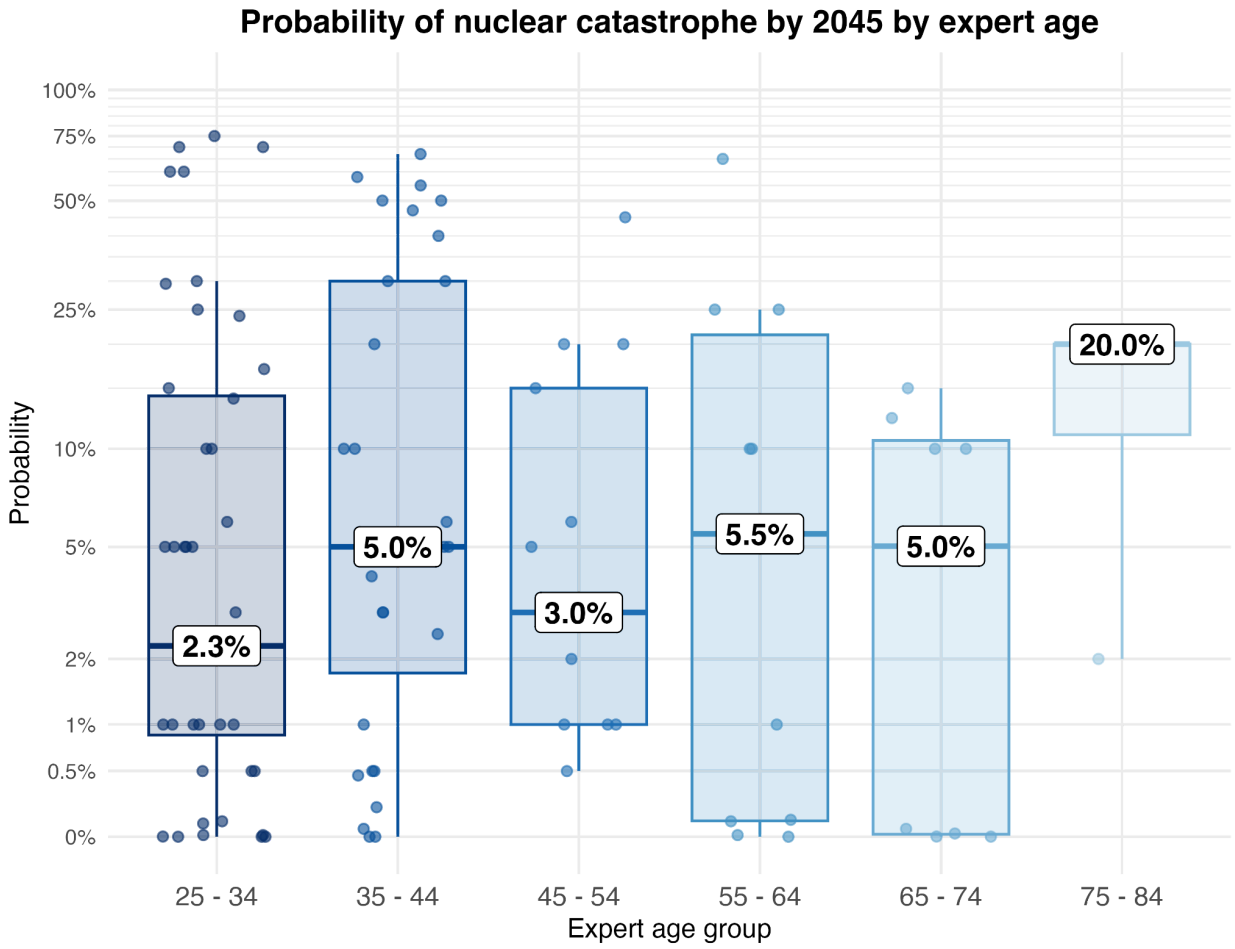

Figure 32: *Forecasts on the probability of catastrophe disaggregated by age group (experts only). The median forecast is provided in text. The 18–25 age group for experts is not displayed in the chart due to insufficient sample size (n=1), which does not meet the minimum threshold (n=3) for inclusion in the boxplot visualization. The boxes show the 25th–75th percentile forecasts, and the lines the range of forecasts minus outliers. We jitter the data points horizontally to allow for better visualization of the distribution of forecasts. Horizontal variation within each group serves no other empirical purpose. The y-axis uses a logarithmic scale to informatively show variation in forecasts in the 0–10% range.*

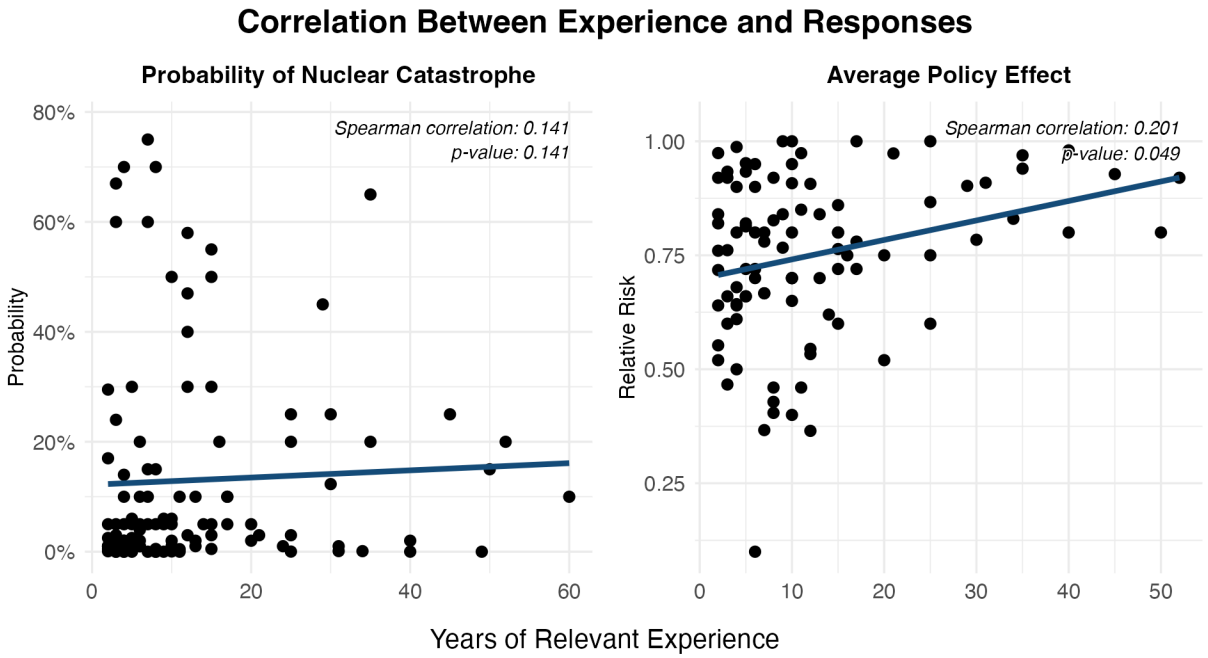

Figure 33: *Correlation between years of relevant experience and forecast of probability of catastrophe (left) and average relative risk for five general policies (minus Sole Authority) (right). This only shows data from experts.*

There was a trend toward participants who reported affiliation with government giving lower forecasts of the probability of nuclear catastrophe, and those working in advocacy organizations giving higher responses. However, given the small sample sizes, these differences were not statistically significant (see Figure 34, and Appendix 17 for further detail). There was no difference in average relative risk for the general policies, and no clear trend across organizations (see Appendix 17).

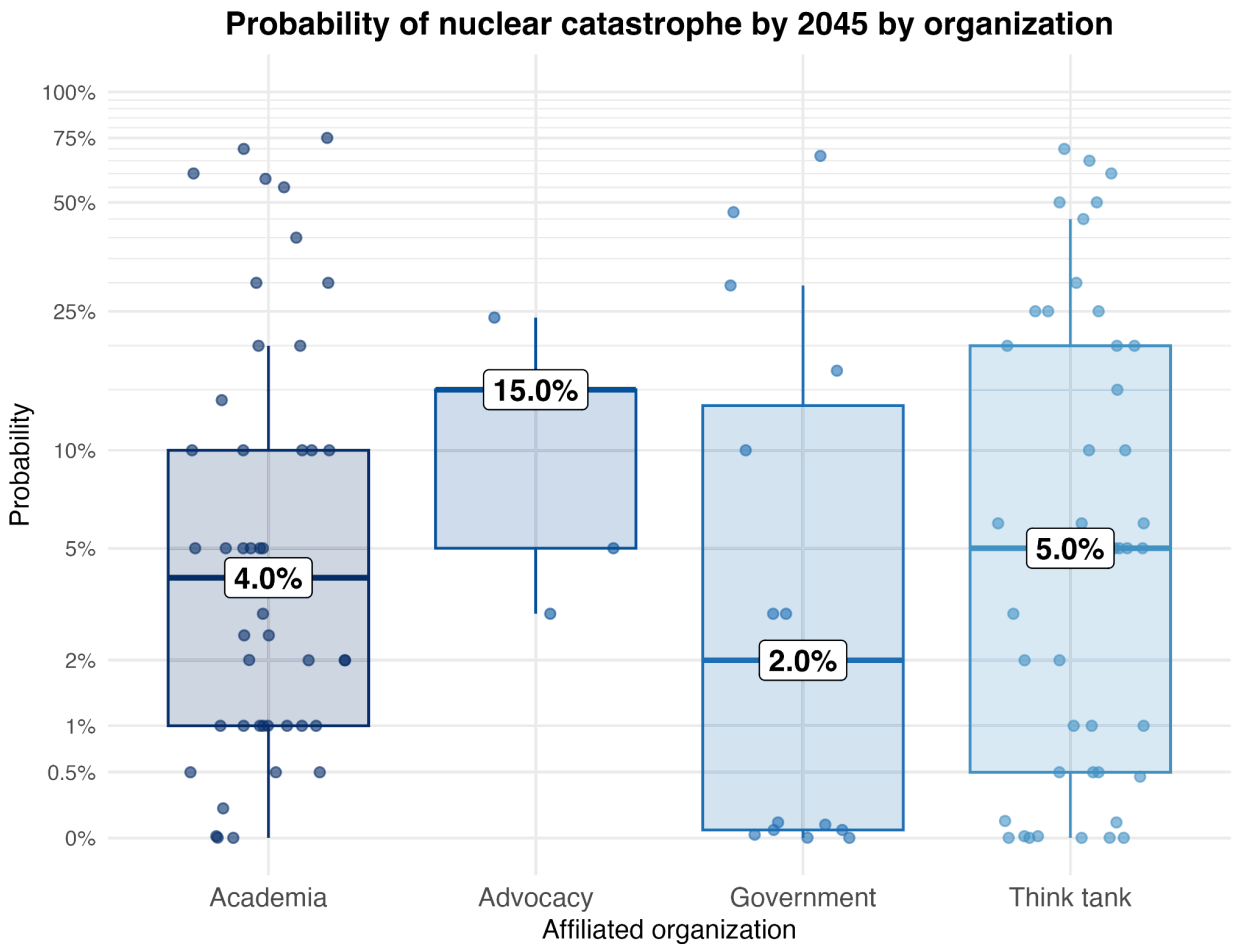

Figure 34: *Forecasts on the probability of catastrophe disaggregated by type of affiliated organization (experts only). The median forecast is provided in text. The boxes show the 25th–75th percentile forecasts, and the lines the range of forecasts minus outliers. We jitter the data points horizontally to allow for better visualization of the distribution of forecasts. Horizontal variation within each group serves no other empirical purpose. The y-axis uses a logarithmic scale to informatively show variation in forecasts in the 0–10% range.*

6.2 Beliefs about contentious issues

We analyzed how participants' stated beliefs about contentious issues in nuclear weapons policy interacted with their forecast of the probability of nuclear catastrophe by 2045. Experts who thought that deterrence is inherently fragile and that nuclear escalation is very likely had higher median forecasts of nuclear catastrophe, but the difference was not statistically significant. Superforecasters showed the opposite pattern, but this was also not statistically significant. Figures 35 and 36 show the distribution of forecasts disaggregated by views on nuclear deterrence and the likelihood of nuclear escalation.

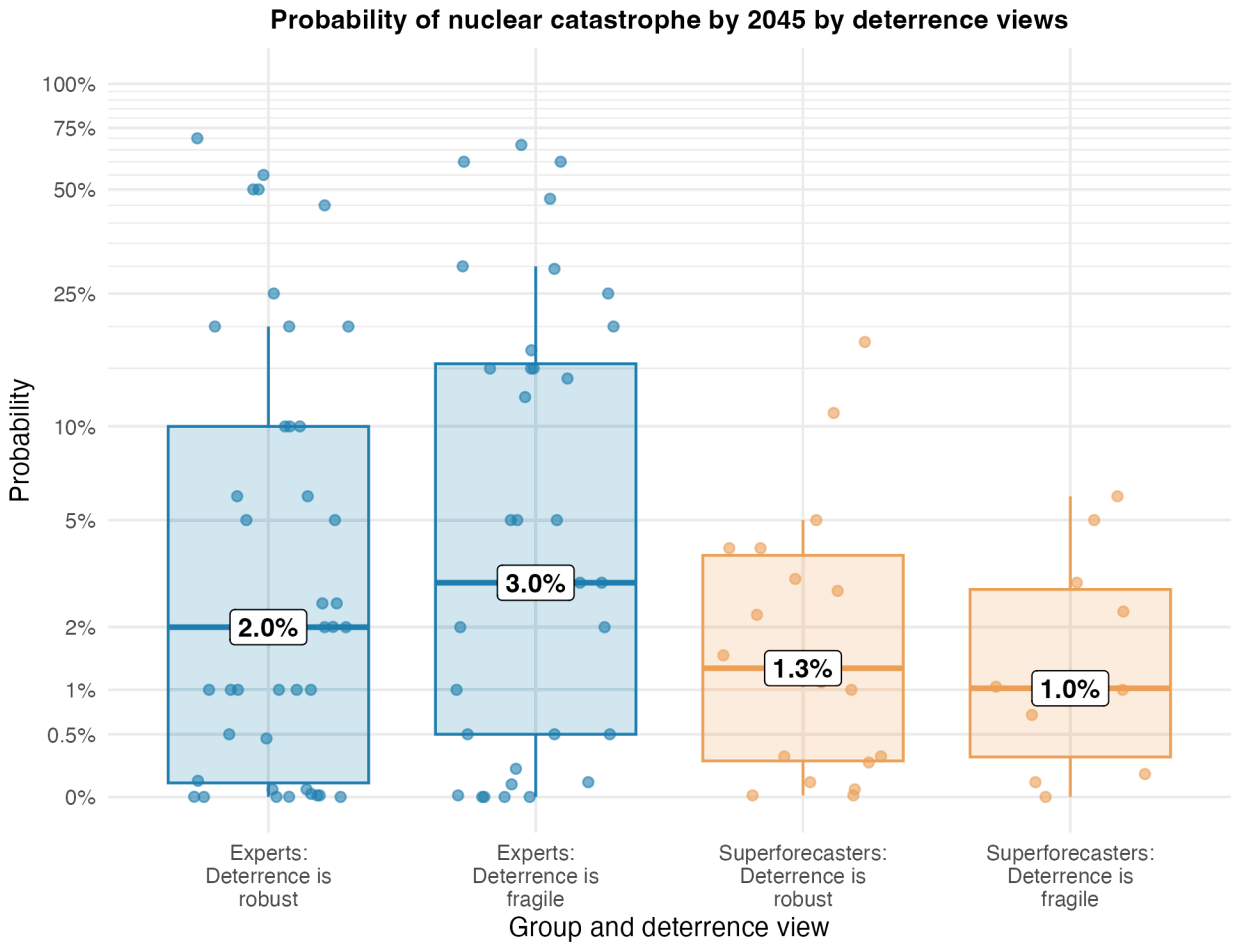

Figure 35: *Forecasts on the probability of catastrophe disaggregated by beliefs about the fragility / robustness of nuclear deterrence. The median forecast is provided in text. The boxes show the 25th–75th percentile forecasts, and the lines the range of forecasts minus outliers. We jitter the data points horizontally to allow for better visualization of the distribution of forecasts. Horizontal variation within each group serves no other empirical purpose. The y-axis uses a logarithmic scale to informatively show variation in forecasts in the 0–10% range.*

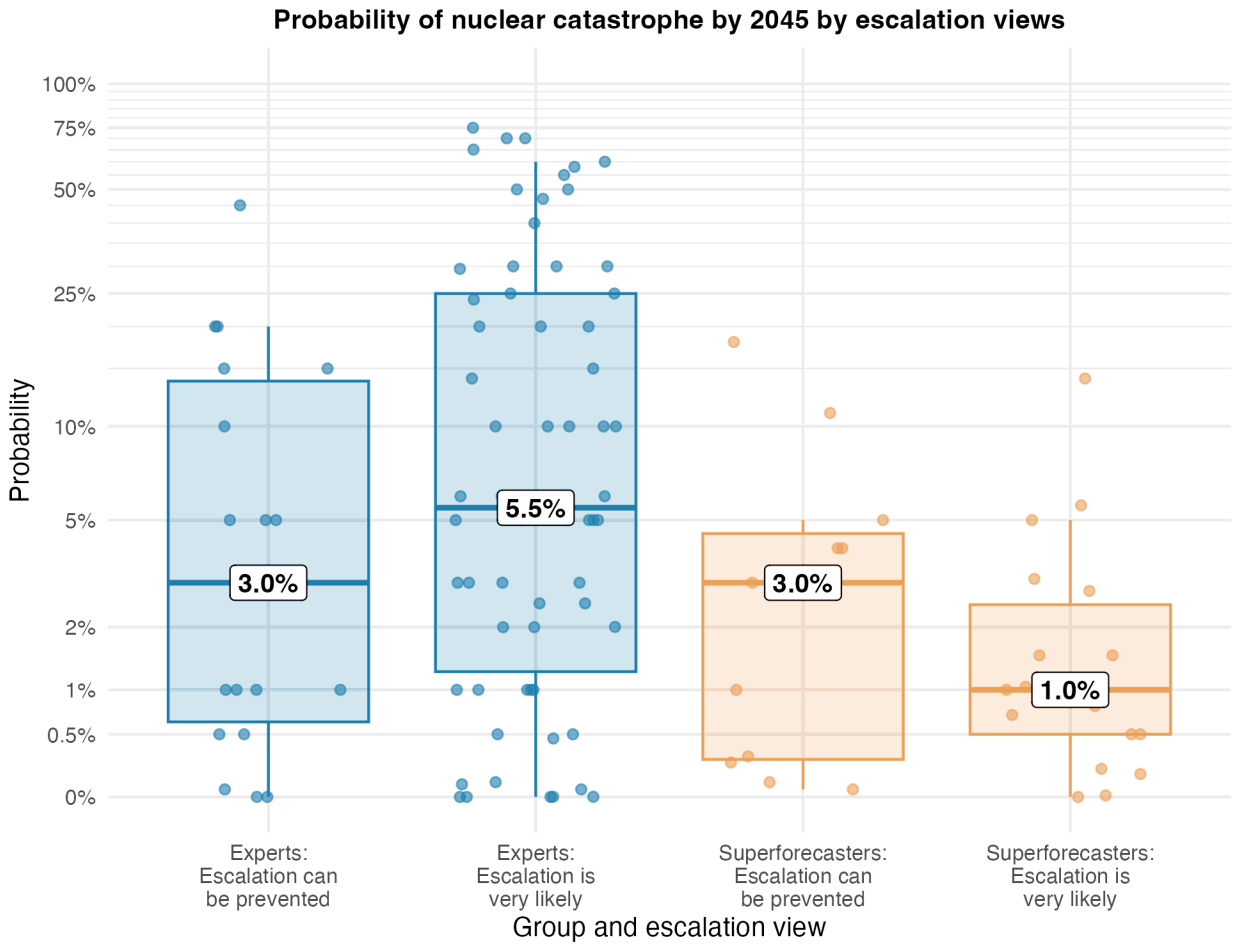

Figure 36: *Forecasts on the probability of catastrophe disaggregated by beliefs about the likelihood of nuclear escalation after an initial nuclear strike. The median forecast is provided in text. The boxes show the 25th–75th percentile forecasts, and the lines the range of forecasts minus outliers. We jitter the data points horizontally to allow for better visualization of the distribution of forecasts. Horizontal variation within each group serves no other empirical purpose. The y-axis uses a logarithmic scale to informatively show variation in forecasts in the 0–10% range.*

Table 11 compares the mean (average) rank given to the two most popular policies by participants who had selected the opposing statements for the contentious policy issues. Superforecasters who agreed with the statement that deterrence is inherently fragile ranked the crisis communications network significantly more favorably than did superforecasters who agreed with the statement that deterrence is robust. There was no significant difference (or any clear trend) in the average relative risk of the five general policies (minus Sole Authority) across the different views on the contentious policy issues (see Appendix 17 for details).

Statement selected as closest match to views[40]	Crisis communications Network				Failsafe reviews			
	Expert		Superforecaster		Expert		Superforecaster	
	Mean rank	p-value	Mean rank	p-value	Mean rank	p-value	Mean rank	p-value
Deterrence								
Deterrence is inherently fragile	3.42	0.75	1.67	0.005	4.33	0.05	3.33	0.31
Deterrence is robust	3.26		3.47		3.41		4.12	
Escalation								
Nuclear escalation is very likely	3.53	0.15	2.71	0.61	4.07	0.05	3.77	0.85
Nuclear escalation can be prevented	2.83		3.09		3.11		3.91	

Table 11: *Mean rank (out of 9) for the two most popular policies, disaggregated by beliefs on contentious issues. *The p-values compare the responses for the participants who selected the two responses as being closest to their views (it does not compare experts and superforecasters). The p-value is derived from Welch's t-test, evaluating for difference in the distribution of rank between respondents choosing each statement, within expert and superforecaster groups.*

6.3 Reciprocal scores

As mentioned, participants were asked to predict what the median expert in the study would forecast for the probability of nuclear catastrophe by 2045, and to predict the median expert's forecast on five of the crux questions that will resolve in 2030. We used these results to generate "reciprocal scores" for each participant.

We found that, compared to experts, superforecasters had better reciprocal scores when predicting the expert median forecast of nuclear catastrophe, but that experts had better reciprocal scores when predicting the expert median forecast of the crux questions. So, the superforecasters were generally better at predicting what experts would say about the probability of a nuclear catastrophe by 2045. But experts were better at predicting experts' views on whether different events related to nuclear risk will or won't occur by 2030. To calculate each participant's accuracy on this "reciprocal scoring" exercise, we rank each participant's accuracy on each question and then average their accuracy rank across each question. Figure 37 shows

[40] Summaries of the full statements are presented here. We suggest reading the full statements, which can be found in Appendix 4.

the ranking of reciprocal scores for forecasts of catastrophe and the ranking of reciprocal scores for forecasts of the crux questions. Ranks closer to one indicate greater accuracy on these questions. Because there were 151 participants who filled out Survey 1, the worst possible rank a participant could receive is 151: this would mean that on all questions, they were less accurate than all other participants at predicting the group's beliefs.

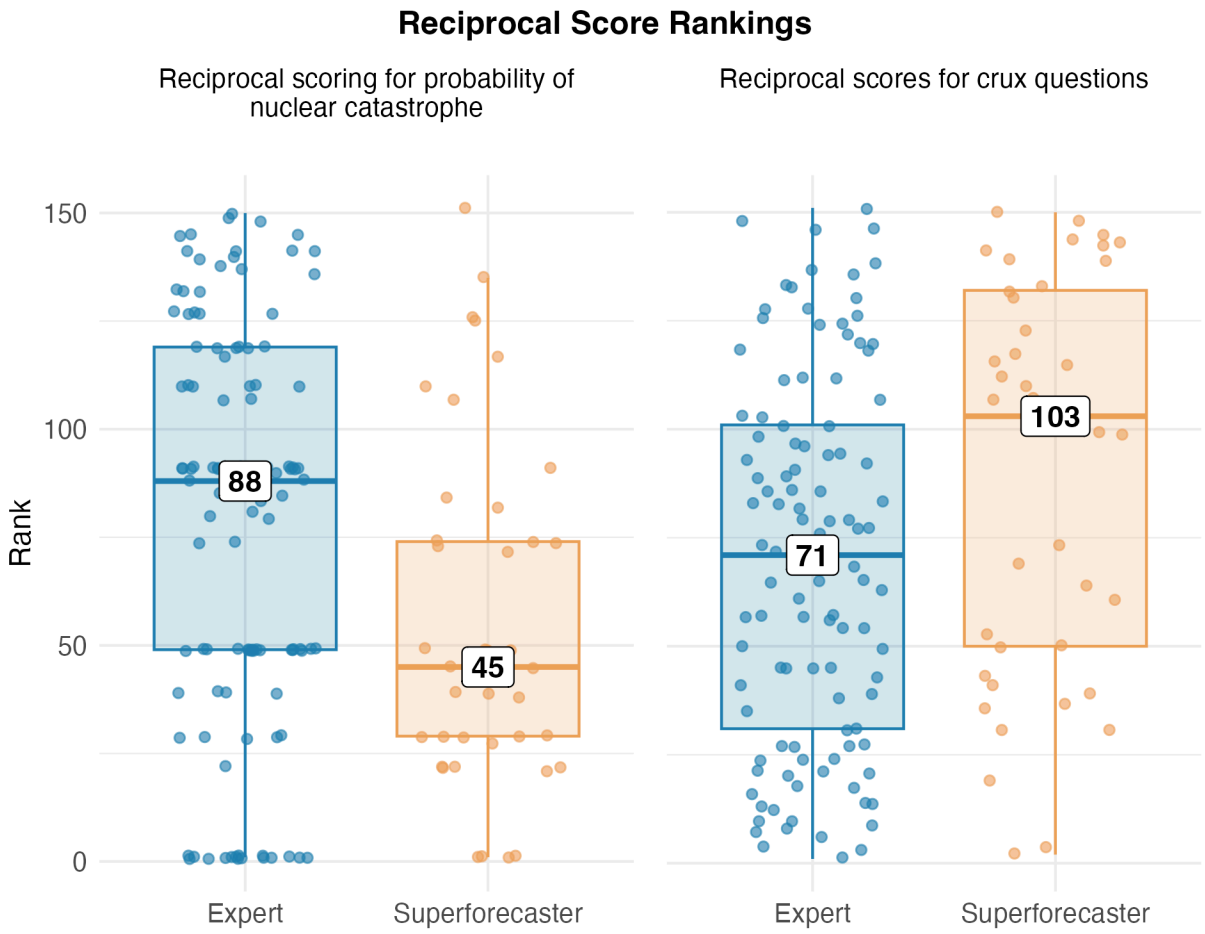

Figure 37: *Reciprocal scores for predicting the expert median forecast of the probability of nuclear catastrophe by 2045 (left) and for predicting the expert median forecasts for the resolution of crux questions (right). Lower scores indicate greater accuracy. The median forecast is provided in text. The boxes show the 25th–75th percentile forecasts, and the lines the range of forecasts minus outliers. We jitter the data points horizontally to allow for better visualization of the distribution of forecasts. Horizontal variation within each group serves no other empirical purpose.*

Figure 38 shows how forecasts of nuclear catastrophe vary according to reciprocal scores. Expert participants who were within the bottom third, in terms of ability to predict the expert median forecast of nuclear catastrophe, gave much higher forecasts of nuclear catastrophe than did others (a median of 25%, compared to 2% for the top third of performers and 0.5% for the middle third. However, experts who were better at predicting expert forecasts of crux resolution generally gave higher forecasts for the probability of nuclear catastrophe by 2045. In superforecasters, there was a slight trend in the opposite direction: the superforecasters who

were better at predicting experts' crux forecasts generally gave slightly lower forecasts for the probability of catastrophe (see Figure 38).

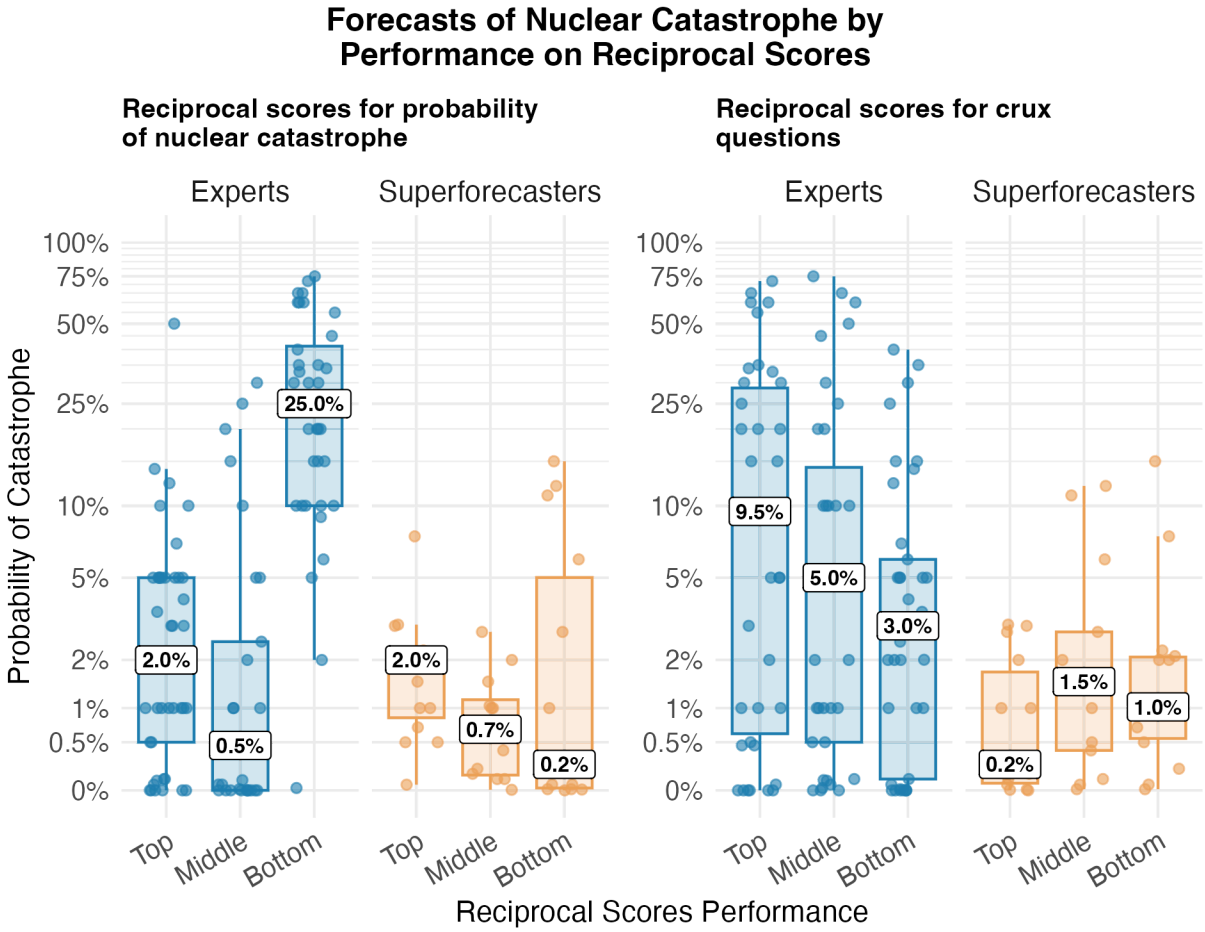

Figure 38: *Probability of catastrophe predictions from the top, middle, and bottom third of expert and superforecaster reciprocal scoring performers (based on both probability of catastrophe reciprocal scoring accuracy and crux question reciprocal scoring accuracy. Each groups' top, middle and bottom thirds are determined within-group (i.e., the top third of experts is composed of the best performers from the Expert camp, even if some of the same individuals wouldn't rank in the top third of overall performers). The median forecast is provided in text. The boxes show the 25th–75th percentile forecasts, and the lines the range of forecasts minus outliers. We jitter the data points horizontally to allow for better visualization of the distribution of forecasts. Horizontal variation within each group serves no other empirical purpose. The y-axis uses a logarithmic scale to informatively show variation in forecasts in the 0–10% range.*

We also found that expert participants who performed better at predicting experts' forecasts of crux resolution tended to forecast a higher probability that policies would be implemented. Conversely, experts who performed better at predicting forecasts of nuclear catastrophe tended to forecast a lower probability that policies would be implemented (Figure 39). There was no significant correlation between superforecasters' reciprocal scores and their views on the likelihood of policy implementation. There was also no significant correlation between reciprocal

scoring ranks (of either group) and views on the effectiveness of policies (see Appendix 17 for more detail).

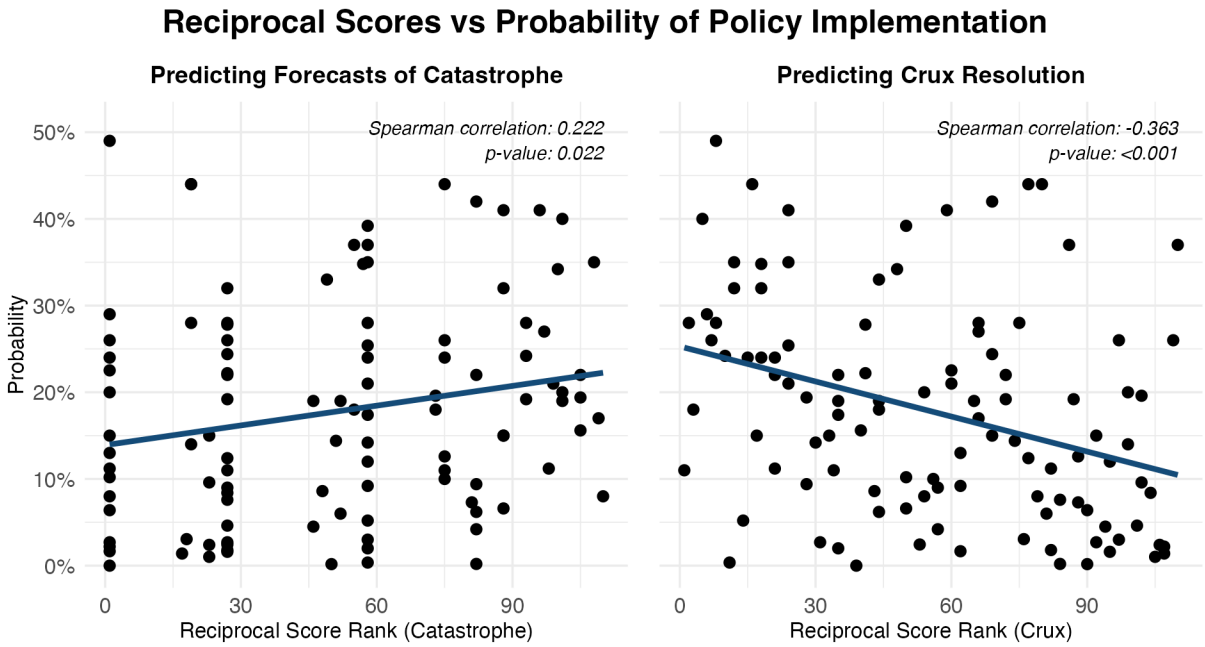

Figure 39: *Correlation between average forecasts of policy implementation (five general policies, excluding "Sole Authority") and reciprocal scoring ranks. Reciprocal scoring rank for predicting the median expert's forecast of nuclear catastrophe is shown on the left and reciprocal scoring rank for predicting the median expert's forecasts of crux resolution is shown on the right. This only shows data from experts.*

While we do have some evidence that accuracy in predicting the aggregate forecast of a group is predictive of actual accuracy on other geopolitical forecasting questions,[41] this evidence base is limited and may not extend to longer-run questions like the ones in this study. As the questions from this study resolve, the results will inform our understanding of this method of assessing forecasting accuracy.

[41] Pavel D. Atanasov et al., "Full Accuracy Scoring Accelerates the Discovery of Skilled Forecasters," *SSRN*, (2023), http://dx.doi.org/10.2139/ssrn.4357367.

7. Limitations

This study has several important limitations. Despite active efforts to recruit a diverse group of expert participants, the final sample was disproportionately from the USA, and to a lesser extent western Europe. Although we had some success with efforts to recruit participants from South Asia, there were very few participants from eastern Europe and eastern Asia. Given the importance of Russia, China, and North and South Korea to the global nuclear weapons situation, it is disappointing that we have few participants with direct experience within these countries represented in the survey. If we were to conduct a similar survey in the future, we would consider partnering with organizations with connections in these countries, and we would consider translating the survey. The survey was only available in English, which was likely an important factor limiting participation from some regions.

Our sample also largely represented experts from academia and think tanks. Although some participants had experience in government, they were in the minority. Future surveys could be strengthened by increased efforts to engage experts within government and the military to understand the perspectives of these groups.

More generally, the number of participants limited some of the conclusions we could draw from this data. Although this was the largest forecasting study of nuclear weapons experts, we would need a bigger sample to determine whether some of the trends we identified are statistically significant (rather than due to chance). This was most notably an issue for the questions on the effects of policies. As we allowed participants to choose a domain to answer questions on, there were some questions about some domains that few participants answered.

This study investigated a global perspective on nuclear weapons. This broad perspective is valuable in providing a holistic assessment of nuclear weapons risk. However, it does mean that the depth to which we could explore aspects of nuclear weapons policy was limited. For example, a study of similar size to this one could be conducted specifically on any one of the adversarial domains we investigated. Limiting the scope of future studies could allow specific topics to be explored in greater depth. We believe there is value in both broader studies such as this one and more focused studies.

While our study included a large number of questions, covering over 20 different topics in the crux questions and over 20 different policies, there are many more questions we could have included. While we tried to achieve a balanced viewpoint in the questions, it’s possible that the ultimate list of policies leans towards policies aimed at reducing nuclear capacities, rather than strengthening nuclear arsenals, which some experts believe would reduce the odds of a nuclear catastrophe through increased deterrence. We did include policies involving Russia and the

USA increasing the role within their arsenals of low-yield nuclear weapons, but generally, policies leaned “dove”-ish in their approach to nuclear weapons policy.

The focus on a single type of nuclear weapons event was another constraint. We did not explore the probability of smaller, more probable incidents or, on the other end of the scale, catastrophes of an even greater magnitude than our main outcome. Given the research on nuclear winters, it is possible that a nuclear war could kill many more than 10 million people. When considering the potential benefits of policies aiming at reducing the risk of nuclear weapons, low-probability but high-consequence events will likely account for much of the expected value of interventions. Therefore, we caution against using these results to estimate the cost-effectiveness of the policies we explored in the survey.

8. Next steps

Every January the Bulletin of the Atomic Scientists updates the “Doomsday Clock” to indicate how close the world is to a nuclear catastrophe.[42] Some experts might pose the question, “So you're recreating the ‘Doomsday Clock’?” And our answer is… not quite.

Our attempt to quantify risk does not solely aim to sound the alarm on nuclear weapons risk. Decision-makers often face a range of threats, each with varying degrees of probability and impact. A quantified risk framework helps clarify which threats are more immediate or severe. It also introduces a systematic approach that minimizes biases, promotes objectivity, and mitigates the influence of noise in the decision-making process. Without a structured approach to quantifying risks, decision-makers may disproportionately emphasize some risks while underestimating or overlooking others. To this end, we hope to provide an illuminating tool to help governments and other decision-makers with competing priorities allocate attention and resources.

The Doomsday Clock update is based on a survey of around 20 experts. This study, in a sense, provides a more molecular reading of the status of nuclear risk by incorporating more experts and enabling them to systematically assess and express risks using probabilities. However, nuclear weapons risk is a large and complicated topic. Our study offers a broad overview of the risk landscape, but much more could be done to investigate specific aspects of this landscape in greater depth. For example, future work could explore how a multilateral crisis communications network should operate. How should the center attempt to overcome problems that have plagued bilateral communications between adversaries, such as a lack of engagement and a

[42] “Doomsday Clock,” Bulletin of the Atomic Scientists, accessed October 17, 2024, https://thebulletin.org/doomsday-clock/current-time/.

lack of trust between leaders? How should leaders respond when such crises arise? Future studies could focus on these and other more detailed questions. Rather than providing all the answers, our study serves as a basis to build upon with future work.

More engagement with policymakers could also be highly beneficial. It would be ideal to include policymakers in the process of designing studies—particularly the forecasting questions and policies to be evaluated—as well as have them participate in surveys. Improved, future versions of these studies could help track views on nuclear weapons with enough granularity to inform policy choices.

There is scope for a wider range of activities that bring a systematic approach to assessing nuclear risks. For example, researchers could use foresight exercises and scenario planning sessions to further interrogate significant findings from the study. There is also potential to combine insights from open-source information to understand and monitor early warning indicators for nuclear escalation.

9. Conclusion

This year, 2024, has witnessed the intensification of two major geopolitical conflicts: Russia-Ukraine on the one hand, and Israel-Gaza (and now Lebanon) on the other. Policymakers and diplomats are seeking to broker ceasefire, de-escalation, and détente, but the biggest challenge they face is the degradation of communication channels. As we write this in October 2024, the recent rounds of escalation in the Middle East have demonstrated the difficulty of exercising restraint. This highlights the importance of one of the most popular policies in this study, a crisis communications network. The other most popular policy, failsafe reviews, suggests a proactive approach to identifying areas where misunderstandings or miscommunication might arise. While nuclear weapons are a complex problem, the participants in this survey were optimistic that steps can be taken to reduce the risk they pose.

It’s difficult to compare highly complex and abstract threats like nuclear war to other existential risks without a common metric. Using probabilities allows for a more nuanced understanding of how nuclear risks stack up against other potentially catastrophic events. Quantifying the risk of a nuclear catastrophe alongside other existential risks provides a clearer framework for understanding and communicating which threats require immediate action, sustained attention, or strategic monitoring. By translating abstract concerns into measurable probabilities, it becomes easier to engage in informed, rational prioritization amid a chaotic and noisy political environment.

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Appendices

A1. Appendix 1: Public surveys of attitudes and beliefs about nuclear weapons risk

The table below shows surveys on the perceived threat of nuclear conflict conducted from 2022 to 2024 among American, Russian and British citizens.

Question	Answers	Participants	Date	Source
How likely do you think we are to get into a nuclear war within the next ten years?	"Very likely": 29% "Fairly likely": 38% "Fairly unlikely": 14% "Very unlikely": 4% “Don’t know”: 15%	1,000 US adults	Feb 2024	Statista US online survey
	"Very likely”: 11% “Fairly likely”: 23% “Fairly unlikely”: 23% “Very unlikely”: 17% “Don't know”: 26%	3,411 US adult citizens	Feb 2022	YouGov study
How concerned are you personally about experiencing nuclear war?	"Very concerned”: 32% “Somewhat concerned”: 37% “Not too concerned”: 20% “Not concerned at all”: 11%"	5.405 US adult citizens	Mar 2022	YouGov study
Do you think there is a threat of a military conflict involving nuclear weapons in the world today, or is there no such threat?	"There is": 71% "There is not": 20%	1,500 Russian adult citizens	Oct 2023	FOMnibus survey
Do you think there will be nuclear war in your lifetime?	"I do”: 24% “I do not”: 29% “Don’t know”: 47%	3,473 UK adults	Mar 2022	YouGov study

How likely or unlikely do you think it is that Russia would launch a nuclear attack against the West?	"very likely": 10% "fairly likely": 23% "fairly unlikely":30% "very unlikely": 12%	1,690 UK adults	Feb 2022	YouGov study

Table A1: *Results of surveys of the public on nuclear weapons risk.*

A2. Appendix 2: Additional Information on Methods

Interviews

As an initial step towards identifying the most important factors that inform views on nuclear risk, we interviewed 14 people with extensive experience of nuclear weapons policy issues. We relied on ONN's knowledge and expertise to identify nuclear risk experts for these interviews. The experts were selected on the basis of their depth of expertise and diversity of their experience. Experts included people based in India, Pakistan, Russia, Australia, Japan, and the USA.

Interviews focused on identifying potential ideological cruxes—that is, questions whose answers would influence views on the risk of nuclear catastrophe and where there is likely to be disagreement amongst experts.

The interviews followed a semi-structured format. The list of interview questions is provided below, but we deviated from these in some instances to allow the interview to flow naturally. Interviews were recorded and transcribed with the interviewees' consent.

- What is the probability that, before 2040, one or more incidents involving nuclear weapons will be the cause of death for more than 10 million people within a 5-year period?
- What factors are most important for this forecast?
- What are some scenarios where this could occur? How would they come about?
- Imagine that in 2030,
- your assessment of this risk has increased substantially. What do you think would've happened in the world to cause this change?
- your assessment of this risk has decreased substantially. What do you think would've happened in the world to cause this change?
- If you could have any piece of information about the world at the end of 2025, or around 2030, what information would you ask for to improve your prediction?
- Which are your top cruxes?
- Anything else that we haven't talked about that is important to your assessment of this risk?

Survey 1

Two researchers identified potential crux questions from the interview transcripts and grouped these into topics based on the core idea of the question.

For example, the list below shows possible cruxes pulled from the expert interviews that were classified under the topic “diplomatic crisis”:

- Will there have been a diplomatic crisis between one of the dyads?
- Will crisis between India and Pakistan escalate to the level it did in 2019?
- Accidental launch of missile by India or Pakistan (similar to March 2022 incident)
- Diplomatic reset or lack of crisis between India and Pakistan
- Have diplomatic relations between any of the dyads been formally severed?
- Lack of dialogue between India and Pakistan
- US withdraws from existing alliances

Where needed, disagreements in classification between the two researchers were resolved through discussion.

To move from this list of topics and potential crux questions to the final list of questions included in the first survey, we first identified the topics that were most commonly discussed by interviewees and then conducted background research to create a long list of potential forecasting questions for each of these topics. For example, below is a list of possible forecasting questions developed for the topic “diplomatic crisis.”

- Will China invade Taiwan by [year]?
- Will the US leave NATO by [year]?
- Will any nation-state leave NATO by [year]?
- Will there be at least one Important Agreement between India and Pakistan before [year]?
- Will there be a terrorist attack in India that kills at least 10 people and is blamed by India on either Pakistan or Pakistan-based terrorists by [year]?
- Will the United States President publicly threaten to use nuclear weapons against Russia by [year]?
- Will there be over 50 armed forces deaths in an India-Pakistan conflict within the span of a year by [year]?
- Will North Korea launch at least one ICBM in [year]?

From this long list we selected questions based on how well they represent the core idea of the topic, how clear and resolvable they are, and how much they diversify the final set of questions. During this process, we noticed that many crux questions related to interactions between nuclear-armed states or were specific to state dyads. We grouped those questions according to the domain they relate to. The four domains were:

- China and the USA
- India and Pakistan
- Korean Peninsula
- Russia and NATO

Survey 2

Using the results from interviews, the first survey, and policy suggestions published by organizations working on nuclear issues,[43] we developed a list of potential policies to ask about. Out of this list, policies for the second survey were selected with input from analysts from the Open Nuclear Network and other external advisors. Policy selection was based on the policies' potential to influence nuclear risk, their interest to the nuclear weapons policy community, their practicability, and likelihood of implementation.
Similar to the approach in the first survey, the policies were grouped according to the adversarial domain they relate to.

Organizations Reviewed for Survey Recruitment

To recruit participants for this study, we searched relevant professional organizations' web pages for experts' names and contact information. Below is the list of organizations we reviewed.

- Alva Myrdal Center, Uppsala Universitet
- American Global Strategies
- Arms in Control Association
- Asian Institute for Policy Studies
- Asser Institute
- BASIC
- Belfer Center for Science and International Affairs, Harvard Kennedy School
- Bulletin of the Atomic Scientists
- Carnegie Endowment for International Peace
- Center for a new American Security
- Center for Strategic and International Studies
- Federation of American Scientists
- French Nuclear Safety Authority
- Global Catastrophic Risk Institute
- Institute for Science and International Security
- Institute for Security and Development Policy
- Institute of International Relations, Tsinghua University
- James Martin Center for Nonproliferation Studies
- Korea Institute for Defense Analysis
- Korea Institute of Nuclear Safety
- Korea University, Graduate School of International Studies
- Massachusetts Institute of Technology
- McLarty Associates
- Nautilus Institute for Security and Sustainability
- Nordisk Sikkerhet
- Norwegian Radiation and Nuclear Safety Authority

[43] These organizations included but were not limited to: NTI, ACA, FP, OP, Carnegie Endowment, Chatham House, UCS.

- Nuclear Safety and Security Commission
- Nuclear Threat Initiative
- Odessa Center for Nonproliferation
- Österreichisches Institut für Internationale Politik
- Perth USAsia Center
- Prifysgol Aberystwyth University
- RAND
- Research Center for Nuclear Weapons Abolition, Nagasaki
- Seoul National University
- Stimson Center
- Stanford University's Center for International Security and Cooperation
- Swedish Radiation Safety Authority
- The Institute for Peace and Unification Studies, Seoul National University
- The National Committee on North Korea
- The Preparatory Commission for the Comprehensive Nuclear-Test-Ban Treaty Organization
- The Richardson Center
- The University of British Columbia
- Vienna Center for Disarmament and Nonproliferation
- War on the Rocks
- Women of Color Advancing Peace, Security and Conflict Transformation
- Woodrow Wilson Center
- Report: Bennett et al. (2021). Countering the Risks of North Korean Nuclear Weapons. RAND. https://www.rand.org/pubs/perspectives/PEA1015-1.html.

A3. Appendix 3: Survey 1 Questions

Summary

The table below shows the questions of Survey 1, consisting of five numerical forecasting questions that resolve in 2026 and questions that resolve in 2030 on 14 general topics and one topic for each domain. 2026 questions and questions on general topics were answered by all participants.

Questions Resolving in 2026
How many nuclear warheads will there be globally according to the 2026 report from the Federation of American Scientists?
How many nuclear weapons will [country][44] possess according to the 2026 report from the Federation of American Scientists?
How many conflict-related deaths will occur in the calendar year 2025, as part of the

[44] Asked for each of the nuclear states in a participant's chosen domain.

Ukraine-Russia conflict?
How many conflict-related deaths will occur in the calendar year 2025, due to conflicts involving nuclear states, apart from the Russia-Ukraine conflict?
By January 1st 2026, how many UN member states will be a signatory to the Treaty on the Prohibition of Nuclear Weapons?
Crux Questions Resolving in 2030 - General
What is the probability of a [x] non-test detonation of a nuclear weapon occurring before the 1st of January, 2030? a) Accidental b) Inadvertent c) Deliberate
What is the probability that [x] conducts another nuclear weapons test before the 1st of January, 2030? a) North Korea b) Any current nuclear state other than North Korea
What is the probability that [x] conducts a nuclear weapons test or comes into possession of nuclear weapons before the 1st of January 2030? a) Iran b) Any state other than Iran, that is not currently believed to have nuclear weapons c) A non-state actor
What is the probability that, by the 1st of January 2030, there will be: a) Any kind of agreement between two or more nuclear states that prohibits cyberattacks on each other's NC3 systems? b) A statement made by each state with publicly declared nuclear weapons that asserts that humans will remain in control of launching a nuclear weapon?
On January 1st 2030, will the majority of a panel of experts agree that China, Russia, or the United States' nuclear missile submarine (SSBN) fleet has become significantly less reliable for second strike assurance than they were on January 1st 2024, due to improvements in detection/tracking technology?
What is the probability that, on January 1st 2030, a designated panel of experts will agree with the following statements: a) Conventional and nuclear weapons and C3I systems are significantly more intertwined than they were on January 1st 2024? b) Nuclear weapons and nuclear C3I systems are significantly more vulnerable to non-nuclear threats than they were on January 1st 2024?
What is the probability that, on January 1st, 2030, the most recent data from the Federation of American Scientists will report that the global number of nuclear warheads in the military stockpile is greater than 13,000?

What is the probability that, by the 1st of January 2030, the US will have formally announced its intention to withdraw from NATO?
Will the United States rejoin the JCPOA, or sign another treaty that restricts Iran's nuclear program, before January 1st, 2030?
What is the probability that, by the 1st of January, 2030, [x][45] will have signed an agreement which limits the number or location of nuclear-capable delivery systems (e.g., launchers, bombers) or nuclear warheads?
What is the probability that [x][3] has a no-first-use policy on January 1st, 2030?
What is the probability that a formal bilateral summit between [x][3] will take place before January 1st, 2030?
What is the probability that, on January 1st, 2030, the most recent score on the V-Dem Liberal Democracy Index for [x][46] will be 0.3 units [higher/lower] than its 2022 score?*
What is the probability that, by January 1st 2030, there will have been more than 500 deaths in militarized conflict between [x][3] in one calendar year?
Questions Resolving 2030 - China and the USA
What is the probability that China launches an invasion against Taiwan before January 1st, 2030?
Questions Resolving 2030 - Russia and NATO
In the year 2029, will there be fewer than 500 conflict-related deaths due to conflict between Russia and Ukraine?
Questions Resolving 2030 - Korean Peninsula
What is the probability that, by the 1st of January 2030, the US will have formally announced its intention to withdraw from the ROK-US Security Treaty?
Questions Resolving 2030 - India and Pakistan
What is the probability that, by January 1st, 2030, a terrorist attack killing at least 30 people occurs in India, and India blames the attack on Pakistan-based terrorists?

* Due to a typographical error, this question was answered differently by different participants, so is not included in the results presented in this report.

[45] X = domain specific
[46] Higher for China, North Korea, India, Pakistan and Russia; lower for the USA.

2030 Crux Questions: Detailed Resolution Criteria and Additional Information

US will have formally announced its intention to withdraw from the ROK-US Security Treaty?

Cross-cutting resolution details

Definition of Nuclear States

We use the term “nuclear states” to refer to states that are widely believed to possess nuclear weapons. This includes states that are recognized as nuclear-weapons states in the Nuclear Non-Proliferation Treaty, states that have declared possession of nuclear weapons but are not recognized in the NPT, and states widely believed to have nuclear weapons but have not yet declared this.

We use the term “current nuclear states” to refer to states that currently (as of February 2024) are widely believed to possess nuclear weapons.

The list of current nuclear states is:

- The United States of America
- Russia
- The United Kingdom
- France
- China
- India
- Pakistan
- North Korea
- Israel

Continuity of States

In the event of a state dissolving or changing its name or borders, we will accept future states that are primarily within the original states’ 2024 borders. Newly-formed countries will be assigned to the country containing the plurality of their landmass according to 2024 borders.

For example, Question 2 asks about North Korea conducting a nuclear weapons test. If the Democratic People’s Republic of Korea dissolves but a new state emerges within, or largely within, the DPRK’s current borders, a test conducted by that new state before 2030 would cause this question to resolve positively.

Non-test detonations: What is the probability of a [x] non-test detonation of a nuclear weapon occurring before the 1st of January, 2030?

a) Accidental?
b) Inadvertent?
c) Deliberate?

Resolution Criteria

- The question will take CTBTO (Comprehensive Nuclear-Test-Ban Treaty Organization) reports that the IMS (International Monitoring System) detected a nuclear detonation as a sign that a detonation occurred.
    - The International Monitoring System (IMS) is a global network of monitoring stations and laboratories that uses four verification methods (seismic, hydroacoustic, infrasound and radionuclide) to detect nuclear explosions. It has so far been effective in detecting North Korea's six declared nuclear weapons tests.
- If an incident occurs before the question's resolution date, but it's yet to be confirmed whether this was a non-test detonation, we will defer to the majority opinion of a panel of experts. The panel will be asked to give their opinion one month after the question's resolution date.
- Any detonation of a radiological dispersal device ("dirty bomb") does not count towards positive resolution.
- For question a), we use the definition provided by Barrett et al. who define an accidental detonation as one where "system safeguards or procedures to maintain control over nuclear weapons fail in such a way that a nuclear weapon … explodes without direction from leaders." (Barrett et al. 2013) This question will resolve as positive if the responsible party publicly acknowledges that the detonation was accidental or if no actor acknowledges responsibility for the detonation.
    - Accidental nuclear detonations of non-combat devices such as reactor meltdowns, incidents related to uranium extraction or enrichment for non-weapon purposes and accidents from nuclear physics experiments do not count towards positive resolution.
- For question b), we use the definition provided by Barrett et al. who define an inadvertent detonation as one in which the attacking group "mistakenly concludes that it is under attack and launches nuclear weapons in what it believes is a counterattack." (Barrett et al. 2013) This question will resolve as positive if a detonation occurs and the responsible party publicly acknowledges that the detonation was conducted intentionally but in response to a misinterpretation of events, or if the majority of a panel of experts believes this was an inadvertent detonation. This includes false-alarm scenarios, the misinterpretation of training exercises, weather phenomena, or malfunctions that incorrectly suggest a nuclear attack or a provocation. (source: Barrett)
    - The public acknowledgement may come from an official spokesperson of the state or organization, or from the head of the government or organization.
- For question c), we use the definition provided by Barrett et al. who define a deliberate detonation as one in which "the attacking nation decides to attack based on accurate information about the state of affairs." (Barrett et al. 2013) This question will resolve as positive if the responsible party does not publicly acknowledge the detonation as accidental or inadvertent.

Historical Base Rate Data

Accidental

So far, there have been no known-of accidental detonations of nuclear weapons. This section provides an overview of accidents around nuclear weapons.

Broken Arrows

An incident involving nuclear weapons that results in the accidental launching, firing, detonation, theft or loss of a nuclear weapon is called a “Broken Arrow”. From the 1950s to the 2000s, there have been at least 32 Broken Arrows. Details of incidents from 1980 onwards are described in the table below.

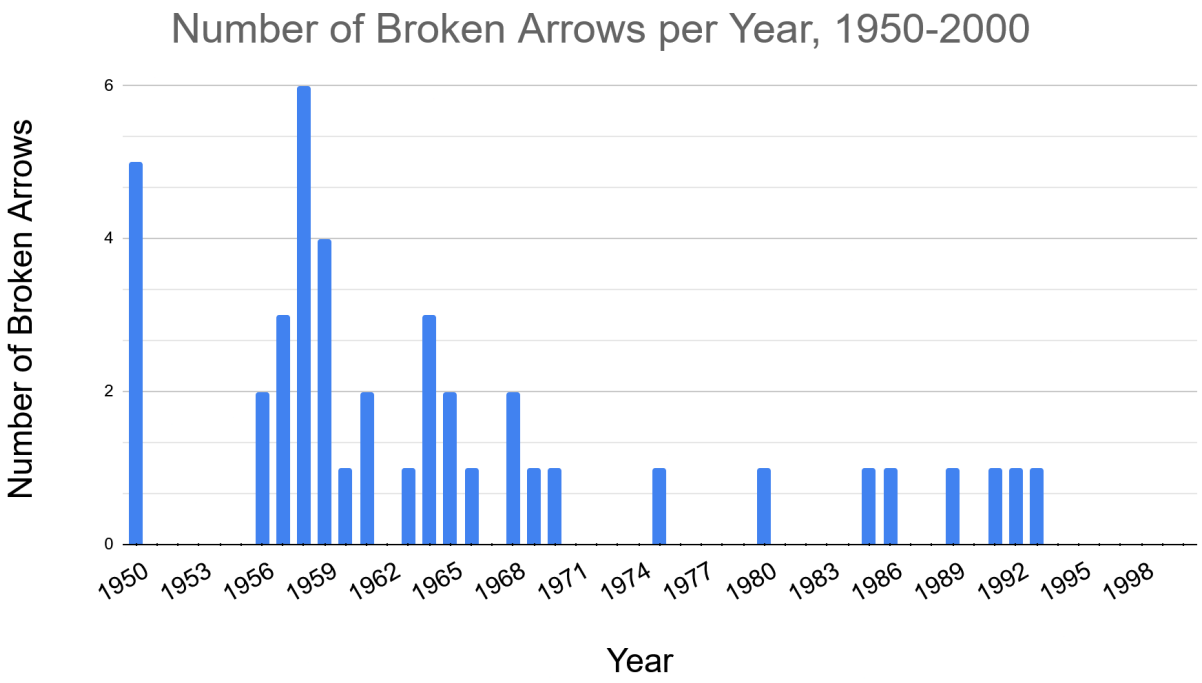

Figure A1: *Numbers of Broken Arrow incidents per year, 1950-2000. Incident details can be found here.*

September 19, 1980	• explosion in an ICBM missile
October 3, 1986	• sinking of a nuclear-powered ballistic missile submarine; loss of two nuclear reactors and 34 nuclear weapons
April 7, 1989	• sinking of a nuclear-powered attack submarine; loss of a nuclear reactor and two nuclear-armed torpedoes
August 10, 1985	• reactor explosion in a nuclear-powered submarine; release of a cloud of radioactivity

September 27, 1991	• missile launch malfunction during a test launch on a nuclear-powered ballistic missile submarine
March 20, 1993	• collision of two nuclear-powered submarines
February 11, 1992	• collision of two nuclear-powered attack submarines

Table A2: *Descriptions of Broken Arrows from 1980-2000.*

Inadvertent

So far, there have been no known-of inadvertent detonations of nuclear weapons. This section provides an overview of incidents that could have plausibly led to inadvertent use of nuclear weapons, such as false alarms, miscommunications or accidents.

Nuclear close calls[47]

Source	Number of incidents	Time span	Frequency
"20 Mishaps That Might Have Started Accidental Nuclear War", Nuclear Files	20	1956-1995	1 every 2 years
"Accidental Nuclear War: A Timeline of Close Calls", Future of Life Institute	24	1956-2016	1 every 2.5 years
"Nuclear close calls", wikipedia	20	1956-2007	1 every 2.6 years
"Too Close for Comfort", Chatham House report	12	1962-2002	1 every 3.3 years
"Close Calls with Nuclear Weapons, Union of Concerned Scientists (pdf)	13 examples for Russia and the US	1960-2010	1 every 3.8 years
"On the Brink - Really?" Revisiting Nuclear Close Calls Since 1945, Bruno Tertrais	3 cases "where the use of nuclear weapons was very seriously considered"	1945-2017	1 every 24 years

Table A3: *Compilations of nuclear close calls and associated frequencies.*

Deliberate

[47]What constitutes a "close call" is not rigorously defined in either compilation. This accounts for part of the differences in countings.

There have been two deliberate non-test detonations of nuclear weapons, namely the US bombings of Japan in 1945 during WWII (sources: Bulletin of the Atomic Scientists, atomic archive):

- 6th August 1945, USA targeting Hiroshima, Japan: 70,000–140,000 deaths
- 9th August 1945, USA targeting Nagasaki, Japan: 40,000–70,000 deaths

Summits: What is the probability that a formal bilateral summit between [x] will take place before January 1st, 2030?

a) China and the USA
b) Russia and the USA
c) India and Pakistan
d) North Korea and South Korea

Resolution Criteria

- The term 'summit', as used here, refers to a bilateral meeting involving the heads of government of the parties.
    - For example, for the China-US dyad, this would be a meeting between the President of the People's Republic of China and the President of the United States. That being said, if there is some change in the title of the head of government, this question will resolve as positive if the head of governments meet, regardless of what the new designation is.
- The meeting must physically take place with both parties present, either in person or via a secure video conference specifically arranged for this summit. Informal, impromptu, or incidental meetings, not specifically designated as a summit, do not qualify.
- The summit must be a bilateral summit involving only the heads of government from the two states - a meeting of the two heads of government that takes place at a multilateral summit would not be sufficient for positive resolution of this question.
- The summit must occur before January 1, 2030. Any preparatory meetings or preliminary discussions that occur before this date do not constitute the summit itself unless they are officially part of the designated summit event.
- For the summit to qualify, it must be officially announced and recognized by either party's government.
- If the resolution is ambiguous, it will be resolved by a panel of experts.

China and the USA

Historical Base Rate Data

This is a list of some notable meetings between the leader of China and the President of the United States that have occurred since Richard Nixon's 1972 visit to China. This does not include meetings that occurred at multilateral summits (for instance, it does not include the 2022 G-20 meeting between President Biden and President Xi Jinping).

Year	Location	Leaders Involved
1972	Beijing	• Nixon • Mao
1979	Washington D.C.	• Carter • Xiaoping
1985	Beijing	• Reagan • Xiannan
1997	Washington D.C.	• Clinton • Zemin
1998	Beijing	• Clinton • Zemin
1999	Washington D.C.	• Clinton • Zemin
2002	Crawford, Texas	• Bush • Zemin
2006	Washington D.C.	• Bush • Jintao
2009	New York	• Obama • Jintao
2011	Washington D.C.	• Obama • Jintao
2013	Rancho Mirage, USA	• Obama • Jinping
2015	Washington D.C.	• Obama • Jinping
2017	Palm Beach, USA	• Trump • Jinping
2023	California	• Biden • Jinping

Table A4: *List of meetings between the President of the United States and the leader of China. This list does not include meetings that took place during and at multilateral summits, such as sideline meetings during the G-20.*

Other Helpful Information

- Carnegie: Three Takeaways From the Biden-Xi Meeting

Russia and the USA

Historical Base Rate Data

This is a list of notable meetings between the US President and the leader of the USSR. It does not include meetings that occurred at multilateral summits such as the meetings between Churchill, Stalin and Roosevelt (1943-1945) or a meeting in 1991 during the G7 summit.

Year	Location	Leaders Involved
1959	Washington D.C.	• Eisenhower • Khrushchev
1961	Vienna	• Kennedy • Khrushchev
1967	Glassboro	• Johnson • Kosygin
1972	Moscow	• Nixon • Kosygin
1973	Washington D.C.	• Nixon • Kosygin
1985	Geneva	• Reagan • Gorbachev
1986	Reykjavik	• Reagan • Gorbachev
1987	Washington D.C.	• Reagan • Gorbachev
1988	Moscow	• Reagan • Gorbachev
1988	Governor's Island	• Reagan • Gorbachev
1989	Birżebbuġa	• Bush • Gorbachev
1990	Washington D.C.	• Bush • Gorbachev
1990	Helsinki	• Bush • Gorbachev
1991	Moscow	• Bush • Gorbachev

Table A5: *List of bilateral meetings between the President of the United States and the Head of Government of the Soviet Union. This does not include meetings that took place at multilateral summits.*

This is a list of notable meetings between the US President and the leader of Russia since the collapse of the USSR. It does not include meetings that occurred at multilateral summits, such as those that occurred at G-20 meetings.

Year	Location	Leaders Involved
1993	Vancouver	• Clinton • Yeltsin
1994	Moscow	• Clinton • Yeltsin
1995	New York	• Clinton • Yeltsin
1997	Helsinki	• Clinton • Yeltsin
2001	Slovenia	• Bush • Putin
2002	Moscow	• Bush • Putin
2005	Slovakia	• Bush • Putin
2009	Moscow	• Obama • Medvedev
2010	Prague	• Obama • Medvedev
2018	Helsinki	• Trump • Putin
2021	Geneva	• Biden • Putin

Table A6: *List of bilateral meetings between the President of the United States and the President of Russia. This does not include meetings that took place at multilateral summits, such as meetings that occur during and at a G-20 Summit.*

Other Helpful Information

- POLITICO (2022): White House taking every step possible to avoid direct Biden-Putin encounter at G-20

India and Pakistan

Historical Base Rate Data

This is a list of bilateral meetings between the Prime Ministers of India and Pakistan since 1972.

Year	Location	Leaders Involved
1972	Simla	• Indira Gandhi • Zulfikar Ali Bhutto
1988	Islamabad	• Rajiv Gandhi • Benazir Bhutto
1999	Lahore	• Atal Bihari Vajpayee • Nawaz Sharif
2001	Agra	• Atal Bihari Vajpayee • Pervez Musharraf

Table A7: *List of formal bilateral summits between the Prime Minister of India and the Prime Minister of Pakistan since (and including) the Simla Agreement in 1972.*

Other Helpful Information

- Guardian (2015): Indian prime minister makes surprise stopover in Pakistan

North Korea and South Korea

Historical Base Rate Data

This is a list of Inter-Korean summits.

Date	Location	Leaders Involved
June 13th - 15th, 2000	Pyongyang, North Korea	• Kim Jong-il • Kim Dae-jung
October 2nd - 4th, 2007	Pyongyang, North Korea	• Kim Jong-il • Roh Moo-hyun
April 27, 2018	Panmunjom, DMZ	• Kim Jong-un • Moon Jae-in
May 26, 2018	Panmunjom, DMZ	• Kim Jong-un • Moon Jae-in
September 18–20, 2018	Pyongyang, North Korea	• Kim Jong-un • Moon Jae-in

Table A8: *List of Inter-Korean summits between the Supreme Leader of the DPRK and the President of South Korea.*

Other Helpful Information

- Al Jazeera (2024): North Korea ends all economic cooperation with South as ties hit new low

Tech Agreements: What is the probability that, by the 1st of January 2030, there will be:

a) Any kind of agreement between two or more nuclear states that prohibits cyberattacks on each other's NC3 systems?
b) A statement made by each state with publicly declared nuclear weapons that asserts that humans will remain in control of launching a nuclear weapon?

Resolution Criteria

- a) We use the term 'agreement' to refer to any formal and documented understanding between two or more states. This may include treaties, accords, joint statements outlining agreement, Memoranda of Understanding (MoU), or any other international agreement that is public and verifiable.
    - For this question to resolve positively, the agreement must be signed by at least two nuclear states.
    - NC3 refers to the Nuclear Command, Control, and Communications systems of nuclear-armed states. The agreement must explicitly prohibit cyberattacks aimed at disrupting, manipulating, or damaging NC3 systems. This includes but is not limited to hacking, introducing malware, espionage, and other forms of cyber interference.
- b) A positive resolution requires either: a) a statement from each of the states that has publicly acknowledged their nuclear weapon capacity or b) a joint statement signed by each of those states.
    - A statement that prohibits the delegation of nuclear launch authority to artificial intelligence, or any other automated decision-making process, would see this question resolve positively. The statement does not need to explicitly mention artificial intelligence or automated decision-making. A statement that affirmed the need for human control to be maintained over nuclear launch authority would also satisfy this question. The requirement for human control must be explicitly stated. It is not sufficient if the agreement only alludes to human control in contexts where AI or automated processes are not considered.
    - Currently, the states that would be required to make such a statement for this question to resolve positively are: the USA, Russia, the UK, France, China, India, Pakistan, and North Korea.
    - All of these countries making this statement—made jointly by France, the UK, and the USA—would qualify for resolving this question:
        - "consistent with long-standing policy, we will maintain human control and involvement for all actions critical to informing and executing sovereign decisions concerning nuclear weapons employment"

- The statement must be publicly disclosed by the participating states or through credible international channels by January 1st, 2030. Secret or classified agreements not publicly acknowledged by the involved states do not qualify.
- If the resolution is ambiguous, it will be resolved by a panel of experts.

Historical Base Rate Data

There aren't any previous agreements that prohibit cyberattacks on NC3 systems. Here, we show a table of major international agreements that govern the development, testing, production, and/or use of nuclear weapons, as well as developments and agreements that have otherwise been significantly important to the history of nuclear security.

Treaty/Agreement	Year signed	Year of entry into force
Quebec Agreement	1943	1943
Statute of the International Atomic Energy Agency[48]	1956	1957
US–UK Mutual Defense Agreement	1958	1958
Antarctic Treaty	1959	1961
McCloy–Zorin Accords	1961	1961
Moscow-Washington Hotline Agreement[49]	1963	1963
Partial Nuclear Test Ban Treaty	1963	1963
Polaris Sales Agreement	1963	1963
Outer Space Treaty	1967	1967
Treaty of Tlatelolco	1967	1968
Nuclear Non-Proliferation Treaty	1968	1970
Seabed Treaty	1971	1972
Strategic Arms Limitation Treaty I	1972	1972
Anti-Ballistic Missile Treaty	1972	1972
Threshold Test Ban Treaty	1974	1990

[48] The IAEA Statute, while not governing nuclear weapons directly, is crucial for monitoring nuclear energy use and preventing its diversion to military purposes, including nuclear weapons.

[49] While this is not technically an agreement relating to the production of nuclear weapons, it was established in the aftermath of the Cuban Missile Crisis to manage misunderstandings that could lead to nuclear war.

Peaceful Nuclear Explosions Treaty	1976	1990
Strategic Arms Limitation Treaty II	1979	Never[50]
Treaty of Rarotonga	1985	1986
Intermediate-Range Nuclear Forces Treaty (INF)	1987	1988
Convention on the Physical Protection of Nuclear Material	1980	1987
Ballistic Missile Launch Notification Agreement	1988	1988
Strategic Arms Reduction Treaty (START I)	1991	1994
Lisbon Protocol	1992	1994
Strategic Arms Reduction Treaty II (START II)	1993	2000
Southeast Asian Nuclear-Weapon-Free Zone Treaty	1995	1997
Treaty of Pelindaba	1996	2000
Comprehensive Test Ban Treaty (CTBT)	1996	Never[51]
START III[52]	Never	Never
Strategic Offensive Reductions Treaty (SORT)	2002	2003
International Convention for the Suppression of Acts of Nuclear Terrorism	2005	2007
India–United States Civil Nuclear Agreement	2008	2008
New Strategic Arms Reduction Treaty (New START)	2010	2011
Treaty on the Prohibition of Nuclear Weapons[53]	2017	2021

Table A9: *A table showing international agreements between states that govern the development, testing, production, deployment, and/or use of nuclear weapons. This table includes both agreements that*

[50] Never ratified due to the Soviet invasion of Afghanistan.
[51] The CTBT never officially entered into force as it was not ratified by 10 of the 187 signatories.
[52] START III was a proposed bilateral arms treaty that never went into force.
[53] No nuclear states have entered into this agreement.

were ratified and brought into effect, agreements that were ratified but never brought into effect, and some agreements that were neither ratified nor brought into effect. The table also includes agreements and events that may not be directly related to nuclear security but were important in the history of nuclear security, such as the establishment of the Moscow-Washington hotline.

One agreement of particular relevance to this question (seen in Table A10) is the 2015 US-China cyber agreement, an Executive Agreement announced in a joint press conference attended by President Barack Obama and Chinese General Secretary Xi Jinping on the White House lawn in September 2015.

While the agreement did not have any direct relevance to nuclear security, it did intend to establish a joint dialogue on fighting cybercrime, and stressed that neither country's government would knowingly support cyber-enabled theft of intellectual property.

Year	Agreement/Announcement
2012	United States Achieves Breakthrough on Movies in Dispute with China
2013	United States and China Agree to Work Together on Phase Down of HFCs
2014	U.S.-China Joint Announcement on Climate Change
2014	MoU regarding the rules of behavior for safety of air and maritime encounters
2014	MoU on notification of major military activities confidence-building measures mechanism
2015	U.S.–China Cyber Agreement
2015	U.S.-China Joint Presidential Statement on Climate Change (1)
2016	U.S.-China Joint Presidential Statement on Climate Change (2)
2019/2020	United States and China Reach Phase One Trade Agreement
2023	Sunnylands Statement on Enhancing Cooperation to Address the Climate Crisis

Table A10: *Assorted agreements and announcements between the United States and China.*

Other Helpful Information (Cyberattacks)

- Carnegie: China-U.S. Cyber-Nuclear C3 Stability:
- RAND: The U.S.-China Cyber Agreement: A Good First Step
- Chatham House: Ensuring Cyber Resilience in NATO's Command, Control, and Communication Systems
- Council on Foreign Relations: Why Are There No Cyber Arms Control Agreements?
- Technology for Global Security: Cyber Operations and Nuclear Weapons

- Arms Control Association: Cyber Battles, Nuclear Outcomes? Dangerous New Pathways to Escalation
- Arms Control Association: The New Synergy Between Arms Control and Nuclear Command and Control

Other Helpful Information (Human Control)

- European Leadership Network: AI and nuclear command, control and communications: P5 perspectives
- European Leadership Network: To avoid nuclear instability, a moratorium on integrating AI into nuclear decision-making is urgently needed: The NPT PrepCom can serve as a springboard
- NTI: Assessing and Managing the Benefits and Risks of Artificial Intelligence in Nuclear-Weapon Systems

Nuclear weapons testing: What is the probability that [x] conducts another nuclear weapons test before the 1st of January, 2030?

a) North Korea
b) Any current nuclear state other than North Korea

Resolution Criteria

- A nuclear weapons test consists of a nuclear device detonated in a controlled manner for experimental or demonstrative purposes. Inadvertent, accidental or deliberate detonations do not count towards positive resolution. The testing of radiological dispersal devices ("dirty bombs") does not count towards positive resolution. Subcritical (cold) testing, where the amount of regular fuel does not suffice to sustain a chain reaction, does not count towards positive resolution (when it is unclear whether a test detonation was subcritical or not, the question will be resolved by a panel of experts).
- The last known nuclear weapons test detonation occurred in 2017 and was conducted by North Korea. The last known nuclear weapons test detonations *not* conducted by North Korea were conducted by India and Pakistan in 1998.
- Question a) will resolve positively if the CTBTO (Comprehensive Nuclear-Test-Ban Treaty Organization) reports that the IMS (International Monitoring System) detected a nuclear detonation that is not reported to be a deliberate, inadvertent or accidental detonation, and is within the borders of the North Korea or responsibility for the detonation is claimed by North Korea.
- Question b) will resolve positively if the CTBTO reports that the IMS detected a nuclear detonation that is not reported to be a deliberate, inadvertent or accidental detonation, and the detonation occurs outside the borders of North Korea and responsibility for the detonation is not claimed by North Korea or a non-state actor.
    - If the Democratic People's Republic of Korea dissolves but a new state emerges within, or largely within, the DPRK's current borders, a test conducted by that new state before 2030 would cause this question to resolve positively.

a) North Korea

Historical Base Rate Data

As of February 2024, North Korea has conducted six nuclear weapons tests. (sources: Our World in Data, Nuclear Threat Initiative)

- 2006, one test
- 2009, one test
- 2013, one test
- 2016, two tests
- 2017, one test

In recent years, North Korea has conducted other tests related to nuclear capabilities, such as launch tests of delivery systems capable of deploying nuclear warheads or conventional missile tests.

Year	Test
2017	• two successful ICBM tests (North Korea's military capabilities, Council on Foreign Relations)
2019	• underwater launch of a ballistic missile (source, source)
2022	• ICBM test (North Korea's military capabilities, Council on Foreign Relations)
2023	• test of a submarine possibly capable of deploying nuclear warheads (source)
2023 and 2024	• tests of an underwater drone reportedly capable of deploying a nuclear warhead (source, source)

Table A11: *Overview of recent tests related to nuclear weapons capabilities conducted by North Korea, 2017-2024.*

North Korea has regularly conducted conventional missile tests.

- Missile tests up to 2022:

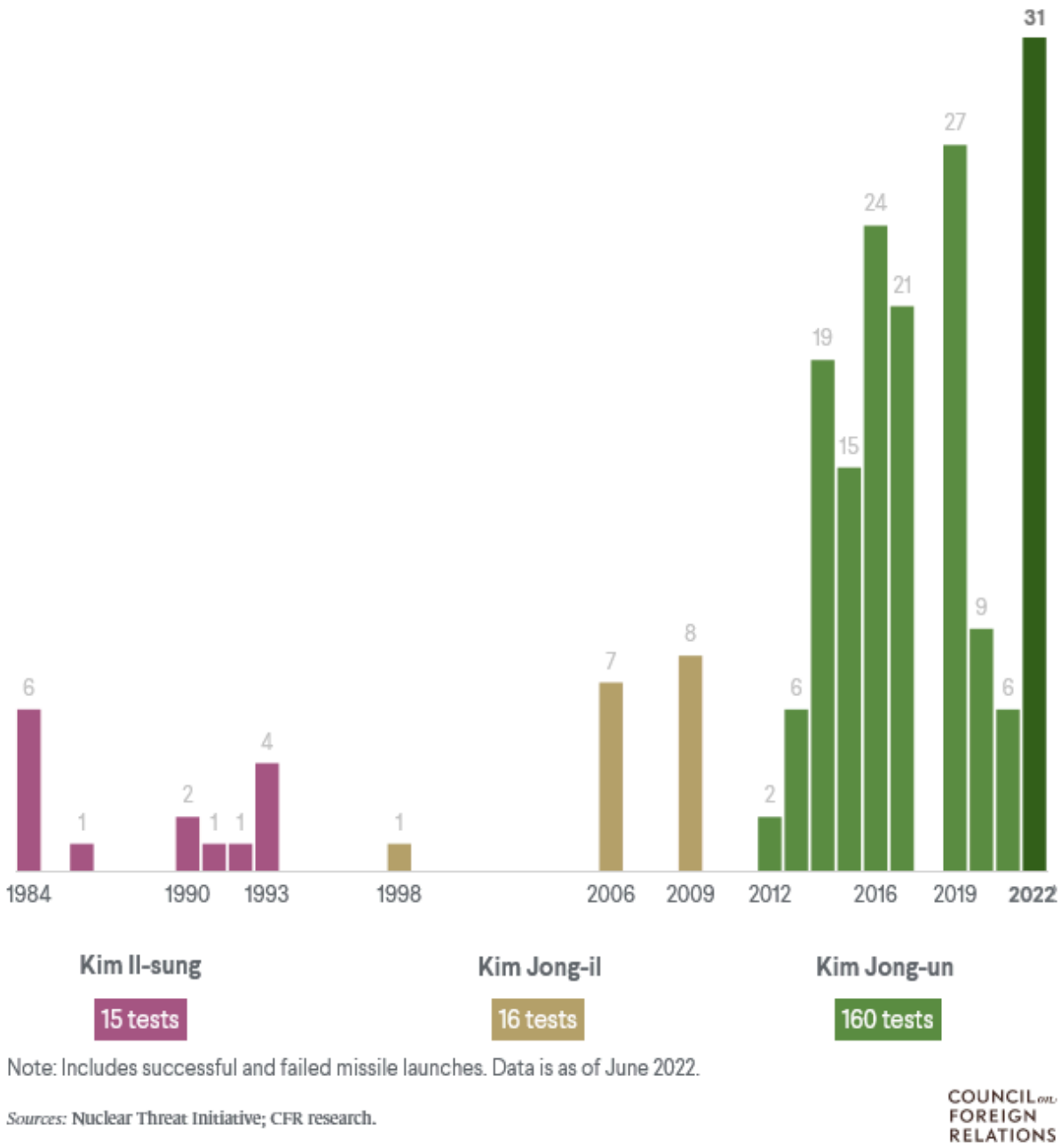

Figure A2: *Number of North Korean missile tests per year, 1984-June 2022, [Council on Foreign Relations](#).*

- [North Korean missile test database, Nuclear Threat Initiative](#) (as of Apr 28, 2023)
- This is an overview of the missile tests conducted by North Korea in 2023.

Month	Missile Tests
February	• One ICBM

	• Two SRBM • Four cruise missiles
March	• Eleven SRBM • Six cruise missiles • One ICBM
April	• One ICBM
July	• One ICBM • Four SRBM • Unconfirmed number of cruise missiles
August	• Two SRBM • Unconfirmed number of cruise missiles
September	• Two SRBM • Two cruise missiles
November	• Unspecified ballistic missile
December	• One SRBM • One ICBM

Table A12: *North Korean missile tests in 2023.*

Other Helpful Information

- North Korea's nuclear posture (North Korean Nuclear Weapons, 2022):
    - North Korea has declared that its nuclear arsenal would only be used "to repel invasion or attack from a hostile nuclear weapons state and make retaliatory strikes". ("Law on Consolidating Position of Nuclear Weapons State Adopted", 2013)
    - Its official declaration of a no-first-use policy followed its fourth nuclear test in 2016, but North Korea reserves the right to strike first with nuclear weapons if its sovereignty is threatened.
        - Korean Central News Agency 2016: "The DPRK [...] will neither be the first to use nuclear weapons nor transfer relevant means and technology [...] as long as the hostile forces for aggression do not encroach upon its sovereignty."
    - North Korea has occasionally extended its nuclear threats to other provocations, e.g. as a response to joint US/SK military exercises.

b) Any current nuclear state other than North Korea

Historical Base Rate Data

- The latest nuclear weapons tests of currently nuclear-armed states (except North Korea) (source):
    - Russia: 1990, one test

    - United Kingdom: 1991, one test
    - United States: 1992, six tests
    - China: 1996, two tests
    - France: 1996, one test
    - India: 1998, two tests
    - Pakistan: 1998, two tests
- Nuclear tests from 1945-present:

Country	1945-49	1950-59	1960-69	1970-79	1980-89	1990-99	2000-09	2010-Present	Total
United States	6	188	428	232	155	21	0	0	1,030
Russia/USSR	1	82	232	227	172	1	0	0	715
United Kingdom	0	21	5	5	12	2	0	0	45
France	0	0	31	69	92	18	0	0	210
China	0	0	10	16	8	11	0	0	45
India	0	0	0	1	0	2	0	0	3
Pakistan	0	0	0	0	0	2	0	0	2
North Korea	0	0	0	0	0	0	2	4	6
Totals	7	291	706	550	439	57	2	1	2,056

India's three simultaneous nuclear explosions on May 11 are counted as only one nuclear test, as are the two explosions on May 13. Likewise, Pakistan's five simultaneous explosions on May 28 are counted as a single test. North Korea's tests in April and May 2010 were too low to be considered actual nuclear tests, and are not counted here.

Table A13: *Number of nuclear tests by country, 1945-present. Source: Nuclear Testing Chronology, Atomic archive, retrieved March 2nd 2024.*

Other Helpful Information

- Treaties prohibiting nuclear testing:
    - Comprehensive Nuclear-Test-Ban Treaty (CTBT)
        - The CTBT bans all nuclear explosions (peaceful or for military purposes).
        - Compliance to the treaty's agreements is monitored by the CTBT organization (CTBTO) through the International Monitoring System (IMS).
        - It was first adopted in 1996 and is signed by 187 states. As of March 2nd 2024, it has not entered into force, but is abided by all states but North Korea. For the CTBT to enter into force, China, Egypt, India, Iran, Israel, North Korea, Pakistan, Russia and the United States have to ratify the treaty. (CTBT, United Nations Office for Disarmament Treaty Database)
    - Partial Nuclear Test Ban Treaty (PNTBT)
        - The PNTBT bans nuclear detonations on the surface, in space or underwater. It allows underground nuclear detonations.
        - It was first adopted in 1963 and has 125 parties. Of the nuclear-armed states, China, France and North Korea have not signed the the PNTBT.
    - Antarctic Treaty
        - The Antarctic Treaty bans nuclear testing, military operations, economic exploitation, and territorial claims in Antarctica.
        - It entered into force in 1961 and is ratified by 56 parties. Of the nuclear states, North Korea and Israel have not ratified the treaty.

    - Treaty on the Prohibition of Nuclear Weapons (TNWP)
        - The TNWP bans the use, possession, testing, and transfer of nuclear weapons. None of the nuclear-armed states have signed or ratified the treaty.
    - Treaties regulating nuclear weapons in space
        - The Moon Treaty bans nuclear weapons on the moon.
        - The Outer Space Treaty bans nuclear weapons in space, including Earth's orbit and the moon.
    - Nuclear-weapon-free-zone treaties
        - Free African Nuclear Weapon Free Zone Treaty (Treaty of Pelindaba)
        - Central Asian Nuclear-Weapon-Free-Zone Treaty
        - Treaty on the Southeast Asia Nuclear Weapon-Free Zone (Bangkok Treaty)
        - South Pacific Nuclear Free Zone Treaty (Rarotonga Treaty)
        - Treaty for the Prohibition of Nuclear Weapons in Latin America and the Caribbean (Tlatelolco Treaty)
- Arms Control Association: The Nuclear Test Tally (nuclear testing up to 2023)
    - Our World in Data presentation of this data: Nuclear Weapons Tests 1945-2022

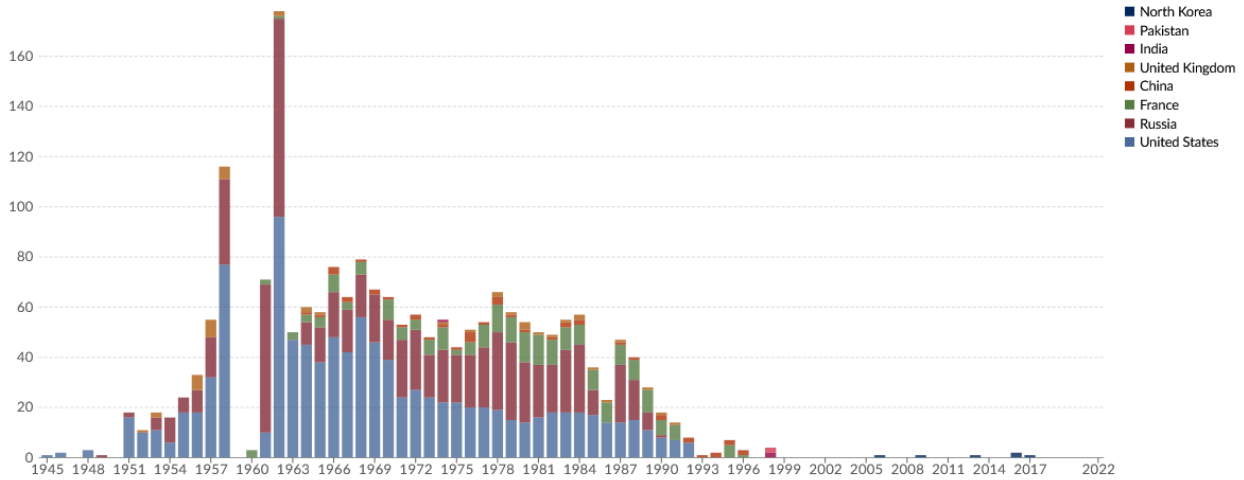

Figure A3: *Number of nuclear weapon's tests per year from 1945-2022 by Our World In Data.*

- Wikipedia: List of nuclear weapons tests

Conflict: What is the probability that, by January 1st 2030, there will have been more than 500 deaths in militarized conflict between [x] in one calendar year?

a) China and the USA
b) Russia and the USA
c) Russia and a NATO country other than the USA
d) India and Pakistan
e) North Korea and South Korea
f) North Korea and the USA

Resolution Criteria

- This question will resolve as positive if at least three credible news reports claim that more than 500 deaths have occurred in armed conflict between the parties in a calendar year period before January 1st 2030. News sources must make reference to reports of deaths from at least one reputable international organization (such as the Red Cross, UN Agencies, or recognized humanitarian NGOs).
- In order for this question to resolve positively, the conflict must occur between the listed states, not between other nations that may be viewed as "proxies" or under the nuclear umbrella" or a state, and not between non-state actors.
- "Armed conflict" corresponds to the term "international armed conflict" as used in international human rights law and in the Geneva Convention. The term includes any use of armed force between two or more states, whether or not a formal declaration of war is made and regardless of the reasons for the conflict. The use of armed force may be unilateral.
- By default, we will resolve this question using data from the Uppsala Conflict Data Program. The question will resolve positively if the number of deaths that arise from a US-Russia conflict exceed 500 in the course of one calendar year between 2024 and 2030. For example, if a similar question had been asked prior to 2022 regarding potential conflict between Russia and Ukraine, we would have used this data to resolve the question. In the absence of such data from the Uppsala Conflict Data Program, we will defer to another conflict dataset produced by a reputable, independent, and non-partisan international organization.
- Deaths that occur as the result of a civil war, natural disaster, or crime, would not qualify as deaths due to armed conflict. Both civilian and military deaths of any nationality would qualify. Deaths as a result of a terrorist attack that is carried out by a terrorist organization not directly affiliated to a government, even if blamed by the government of a nuclear power on another nuclear power or a nation that is protected by a nuclear umbrella, would not qualify as deaths due to armed conflict. For the purpose of this question, groups considered "state-sponsored terrorist organizations" by the US State Department would not count as affiliated to a government.

China and the USA

Historical Base Rate Data

There have not been any direct armed conflicts between the United States and China, although there have been military engagements between the United States and China during the Korean War. The first of these engagements was the Battle of Unsan (a), which involved direct engagement between the People's Liberation Army and the United States Army, and resulted in the death of at least 500 people. Other examples of direct engagement during the Korean War include the Battle of the Ch'ongch'on River, the Battle of Chosin Reservoir, the Chinese Spring Offensive, and the Battle of Heartbreak Ridge. These direct engagements all took place in either 1950 or 1951.

This timeline of US-China relations (a) produced by the Council on Foreign Relations is a useful history of the relationship between the United States and China.

Other Helpful Information

- CFR: Timeline of China-US Relations
- Reuters: Biden says U.S. forces would defend Taiwan in the event of a Chinese invasion
- NYT: China's Military is Making Risky Moves and Adding Nuclear Warheads, U.S. Says
- NYT: Fear and Ambition Propel Xi's Nuclear Acceleration
- CFR: Why China Would Struggle to Invade Taiwan
    - "To invade Taiwan, China would have to conduct an extraordinarily complex military operation, synchronizing air, land, and sea power as well as electronic and cyberwarfare."
    - "The Taiwan Strait, over ninety miles wide, is incredibly choppy, and due to two monsoon seasons and other extreme weather events, a seaborne invasion is only viable a few months out of the year."
    - "China would need to shift military assets to its eastern coast and undertake other visible preparations for an invasion, which Taiwan and the United States would likely be able to detect."

Russia and NATO / the USA

Historical Base Rate Data

While there has not been serious direct conflict between Russia and any NATO member state, including the US, in the post-war period, there were multiple incidents during the Cold War and since the dissolution of the Soviet Union that have been regarded as increasing the likelihood of a direct US-Russia military engagement.

1) **The Berlin Blockade (1948 - 1949):** This was one of the first major international crises of the Cold War. The Soviet Union blocked the Western Allies' railway, road, and canal access to the sectors of Berlin under Western control. The US and its allies responded with the Berlin Airlift to provide supplies to the blocked area, avoiding direct military confrontation.
2) **U-2 Incident (1960):** The downing of a US U-2 spy plane by the Soviet Union caused a major diplomatic crisis. The incident escalated tensions but did not result in direct military conflict.
3) **Cuban Missile Crisis (1962):** Perhaps the closest the US and the Soviet Union came to nuclear war. The crisis was triggered by the Soviet installation of nuclear missiles in Cuba, just 90 miles from the US coast. It ended with a US-Soviet agreement to remove respective nuclear missiles from Cuba and Turkey.
4) **Korean Air Lines Flight 007 (1983):** The Soviet Union shot down a South Korean airliner that had strayed into its airspace, escalating tensions with the US. The incident highlighted the potential for misunderstandings to lead to conflict.
5) **Able Archer 83 (1983):** This was a ten-day NATO command post exercise that the Soviet Union mistakenly believed was a cover for an actual military attack. The heightened alert level in the Soviet Union in response to this exercise brought the two superpowers perilously close to a nuclear confrontation.

6) **Syrian Conflict (since 2011):** The US and Russia have been indirectly involved on opposing sides of the Syrian Civil War. The presence of both nations' military forces in close proximity has raised the risk of direct conflict.
7) **Russian invasion of Ukraine (since 2022):** Russia's large-scale invasion of Ukraine in February 2022 led to severe international condemnation and a robust response from the US and its allies. The US has provided substantial military, economic, and humanitarian support to Ukraine, while imposing severe sanctions on Russia.

Other Helpful Information

- RAND: Postwar U.S. Strategy Toward Russia:

Table 1. Alternative Futures in the Decade After the Russia-Ukraine War

	Hardline U.S. Approach	Less Hardline U.S. Approach
World A: After the Less Favorable War	**Future 1:** Pervasive instability	**Future 2:** Localized instability
World B: After the More Favorable War	**Future 3:** Cold War 2.0	**Future 4:** Cold peace

Figure A4: *Possible futures following different US approaches to the Russia-Ukraine conflict. Source: RAND*

- NYT: Russia's Advances on Space-Based Nuclear Weapon Draw U.S. Concerns
- CNN: Trump says he would encourage Russia to 'do whatever the hell they want' to any NATO country that doesn't pay enough

India and Pakistan

Historical Base Rate Data

There have been around 3,000 deaths in conflict between India and Pakistan between 1989 and 2020.

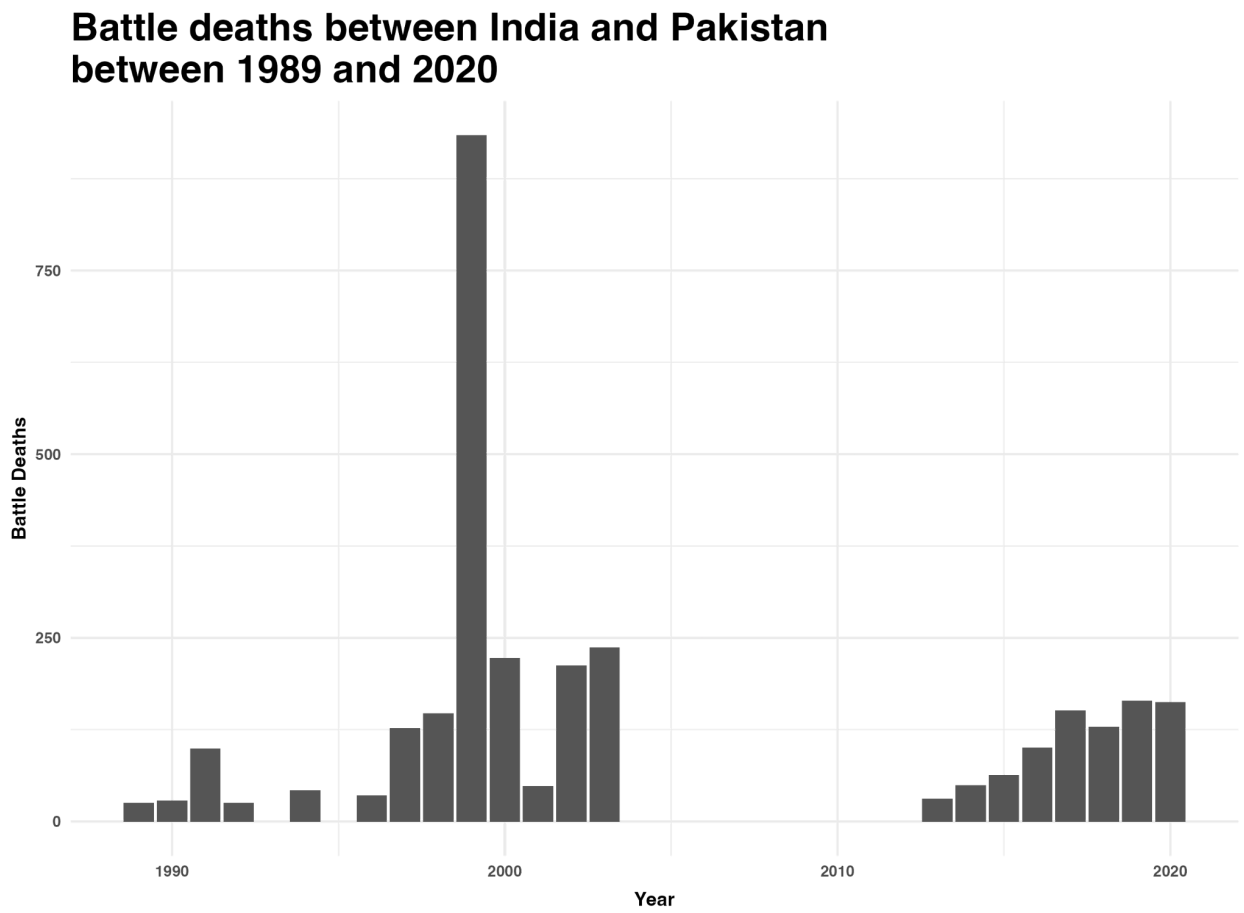

Figure A5: *Battle deaths between India and Pakistan between 1989 and 2020. Source: UCDP*

Around 1,000 of these deaths occurred during the Kargil War (a) in 1999. This is the only year in which over 500 armed conflict deaths occurred over the course of a single calendar year. With the exception of the Kargil War, the most deadly years have been 2000, 2002, and 2003, with 222, 212, and 237 deaths respectively. These deaths occurred in the aftermath of the Kargil War during increased tensions in Kashmir.

Other Helpful Information

- CFR: Conflict Between India and Pakistan
- UCDP: India - Pakistan
- Wikipedia: List of terrorist incidents in India
    - 2001 Indian Parliament attack
    - 2016 Uri Attack
    - 2019 Pulwama attack
- Foreign Policy: Why the India-Pakistan Rivalry Endures
    - “Perhaps more than ever, the two sides face a near impasse. Furthermore, the continuing political uncertainty in Pakistan provides Modi a ready-made excuse to avoid taking the initiative to improve ties. As the politics of Hindu nationalism

become entrenched in Modi's India, the possibilities of any meaningful dialogue look increasingly like a mirage."

North Korea and South Korea / the USA

Historical Base Rate Data

There were over 500 deaths in each year of the Korean War (a), which was fought from 1950 to 1953. There have been no prolonged armed conflicts between the Democratic People's Republic of Korea and South Korea since the end of the Korean War, which ceased as a result of an armistice on the 27th of July, 1953. This means, since 1945, there have been 3 years in which over 500 deaths in an armed conflict occurred, and 76 years in which there were no deaths as a result of a prolonged armed conflict.

That being said, there have been deaths as a result of limited skirmishes around the Demilitarized Zone or other minor engagements between North Korea and South Korea. For example, several soldiers were killed in the 2010 Yeonpyeong bombardment (a), during which North Korean forces fired 170 artillery shells at Yeonpyeong Island.

Other Helpful Information

- CFR: North Korea Crisis
- Missile Threat: North Korean Missile Launches & Nuclear Tests: 1984-Present
- EIU: Belligerence aside, North Korea is not on a war footing
    - "Despite the recent escalation of North Korea's rhetorical hostility towards South Korea and the severance of inter-Korean communications channels, the country's leadership is unlikely to launch a full-on war because of the high possibility of military failure and potentially severe domestic consequences."
    - "We interpret the targeting of South Korea to be aimed primarily at shoring up domestic support for the North Korean leadership and its prioritisation of military development. This could also mean that North Korea no longer deems South Korea to be an effective counterpart for potential negotiations on sanctions relief."
- 38North: Is Kim Jong Un Preparing for War?
    - "The evidence of the past year opens the real possibility that the situation may have reached the point that we must seriously consider a worst case—that Pyongyang could be planning to move in ways that completely defy our calculations. Kim and his planners may target the weakest point—psychologically as well as materially—in what the three capitals hope is a watertight US-ROK-Japan military position. The literature on surprise attacks should make us wary of the comfortable assumptions that resonate in Washington's echo chamber but might not have purchase in Pyongyang. This might seem like madness, but history suggests those who have convinced themselves that they have no good options left will take the view that even the most dangerous game is worth the candle."
- Reuters: North Korea signals confrontation, no signs of war preparation

    - “"While we are not seeing indications of a direct military threat at this time, we continue to monitor for the risk of (North Korea) military action against (South Korea) and Japan," a U.S. official said.
    - South Korean Defence Minister Shin Won-sik this month rejected as an "excessive exaggeration" claims by some U.S. experts that the likelihood of war on the Korean Peninsula was the highest since the Korean War, which ended in an armistice in 1953 - leaving the North and South still technically at war.”

Conflict - Taiwan: What is the probability that China launches an invasion against Taiwan before January 1st, 2030?

Resolution Criteria

- We use the term ‘invasion’ to refer to military forces from the People’s Republic of China entering into Taiwanese territory with the intention of establishing control over the island of Taiwan, or part of the island.
- The invasion must be officially recognized as such by either the United Nations, the government of the United States, or a minimum of three internationally recognized defense or foreign policy institutes.
- The United Nations General Assembly adopted a resolution condemning the Russian invasion of Ukraine in the immediate aftermath of the invasion. This sort of resolution referring to a Chinese invasion of Taiwan would be sufficient for the question to resolve positively.
- It is not a necessary condition for positive resolution that the People’s Republic of China itself acknowledges that it has invaded Taiwan with the intention of taking control of the territory. Whether or not official Chinese government communications explicitly refer to the action as an invasion has no bearing on whether or not the question resolves positively or negatively.
- The military action must involve Chinese military forces entering the island of Taiwan with the intention of taking control of the island is sufficient for positive resolution.
- The invasion itself must occur prior to January 1st, 2030. This question would not resolve positively in the event that preparatory movements or build-ups occurred prior to the resolution date but the actual invasion occurred after the resolution date. The invasion itself must occur prior to the resolution date for positive resolution.
- It need not be the case that the invasion is successful for positive resolution of this question. So long as an invasion is launched by China, the question will resolve positively, even if the invasion is quickly suspended or brought to an end without resulting in Chinese control over Taiwan.
- Other forms of Chinese aggression against Taiwan, such as cyberattacks or sustained allegations of electoral interference, do not constitute an invasion unless accompanied by military action that is intended to result in Chinese control over the island of Taiwan.
- If the resolution is ambiguous, it will be resolved by a panel of experts.

Historical Base Rate Data

This is a table recording historical events that are relevant to cross-strait relations, or are otherwise relevant to the probability that China would invade Taiwan (such as developments in the relationship between Taiwan and the US).

Year	Event
1949	● Establishment of the People's Republic of China ● The ROC government retreats to the island of Taiwan
1950 - 1953	● Major US presence in ROC during Korean War
1954 - 1955	● First cross-strait crisis ● PRC shells islands controlled by the ROC ● United States intervenes to support Taiwan, eventually leading to an easing of tensions
1958	● Second cross-strait crisis ● Air engagements between PRC and ROC forces ● US moves to supply fighter jets and anti-aircraft missiles to ROC ● Crisis subsided with a ceasefire agreement
1971	● ROC expelled from UN, PRC takes their UN seat
1979	● US switches diplomatic recognition from ROC to PRC, but Taiwan Relations Act is passed by US, maintaining unofficial relations with Taiwan
1991	● ROC ends claim to be the government of all China
1992	● 1992 Consensus - tacit understanding that there is only 'one china', but disagreement on what one china actually means
1995 - 1996	● Third cross-strait crisis ● Crisis was sparked by Taiwan's President Lee Teng-hui's visit to the United States in 1995, which was viewed by China as a move towards Taiwanese independence. ● The PRC conducted a series of missile tests in the waters around Taiwan and large-scale military exercises, demonstrating its military capability. ● Crisis defused after the US deployed naval forces in a show of support for Taiwan
2000	● Democratic Progressive Party, supporting Taiwan independence, wins presidency
2008	● Kuomintang wins presidency, improving cross-strait relations
2015	● Ma-Xi Meeting, first meeting between leaders of PRC and ROC since 1949
2016	● Tsai Ing-wen of the pro-independence DPP wins presidency

2020s	• Increased tensions and military activities in the Taiwan Strait
2024	• DPP wins another ROC election

Table A14: *History of Cross-Strait Relations between the People's Republic of China (PRC) and the Republic of China (ROC).*

Other Helpful Information

- Council on Foreign Relations: Why China Would Struggle to Invade Taiwan
- The Week: Will China invade Taiwan?
- CSIS: Surveying the Experts: U.S. and Taiwan Views on China's Approach to Taiwan

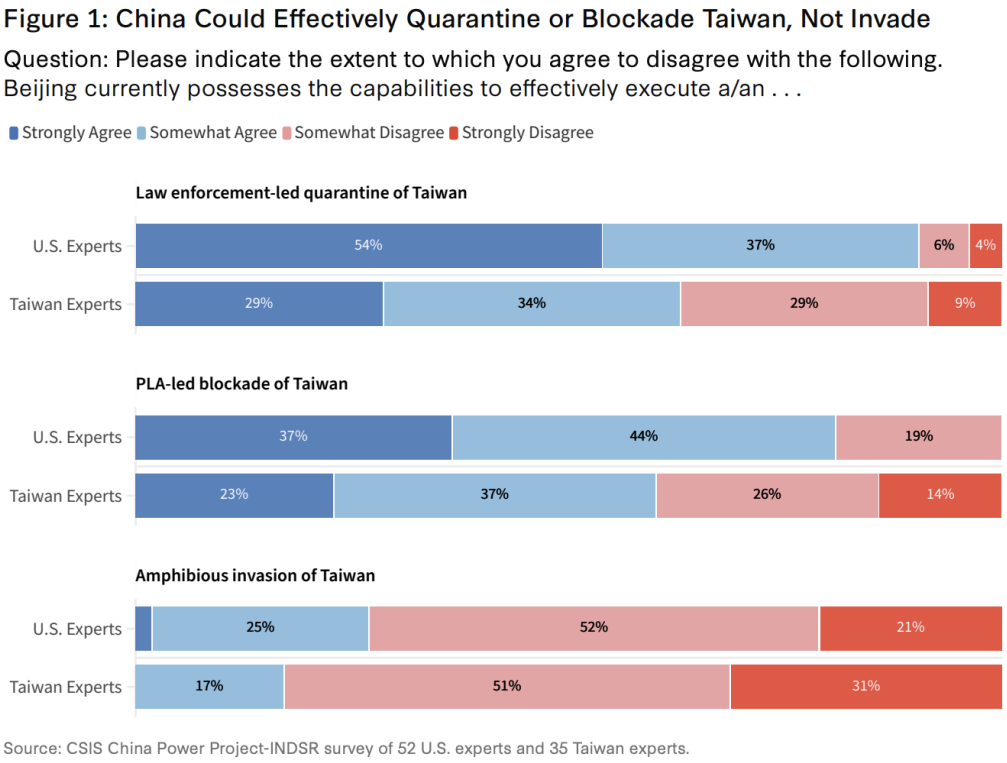

Figure A6: *Survey among U.S. and Taiwan experts about Chinese capabilities to quarantine or blockade Taiwan. Source: CSIS.*

Conflict - Ukraine: In the year 2029, will there be fewer than 500 conflict-related deaths due to conflict between Russia and Ukraine?

Resolution Criteria

- By default, we will resolve this question using data from the Uppsala Conflict Data Program. The question will resolve positively if the number of deaths that arise from a US-Russia conflict exceed 500 in the 2029 calendar year. For example, if the question had been asked about the year 2022, we would have used this data to resolve the question.

- This includes only deaths due to conflict between Ukraine and Russia. Deaths that occur as a result of conflict between one of these parties and a different group (such as separatist groups like the Donetsk People's Republic) will not count towards this question's resolution.
- In the absence of such data from the Uppsala Conflict Data Program, we will defer to another conflict dataset produced by a reputable, independent, and non-partisan international organization. If no such dataset can be found, we will defer to a panel of experts. If the resolution is ambiguous, it will be resolved by a panel of experts.

Historical Base Rate Data

	Estimated fatalities		
Year	high	best	low
2022	160,794	81,970	58,139

Table A15: *Annual estimated fatalities in the Ukraine-Russia conflict in 2022. Source: Uppsala Conflict Data Program, Ukraine - Russia conflict.*

Other Helpful Information

- Atlantic Council: The state of Russia's war on Ukraine as it nears 2024
- New Statesman: How will the war in Ukraine end?
- Carnegie: In Year Three of the Ukraine War, It's Time to Learn the Lessons of the First Two
    - "With Putin's murderous ambitions unchanged, and with Russia possessing superior military capabilities, Ukraine has little choice but to adopt the "active defense" strategy not only for 2024 but for the long run. The goal of liberating all of its occupied territory will remain its objective, but with the correlation of forces favoring Russia decidedly, it is likely unattainable for the foreseeable future."

Conflict - terrorism: What is the probability that, by January 1st, 2030, a terrorist attack killing at least 30 people occurs in India, and India blames the attack on Pakistan-based terrorists?

Resolution Criteria

- We will follow the Global Terrorism Database in defining a terrorist attack as an incident that is an "intentional act of violence or threat of violence by a non-state actor", and where two of the following three criteria are met:
    - The violent act was aimed at attaining a political, economic, religious, or social goal;
    - The violent act included evidence of an intention to coerce, intimidate, or convey some other message to a larger audience (or audiences) other than the immediate victims; and

    - The violent act was outside the precepts of International Humanitarian Law.
- The attack must occur in territory administered by India, including India-administered Kashmir and must be reported to have killed at least 30 people.
- The attack must be blamed by the Indian Government on Pakistan-based terrorists. 'The question will resolve as positive if a leader of the Indian Government or its police or military forces reports that they believe the attack was conducted by Pakistan-based terrorists.
- By default, we will use the Global Terrorism Database to identify terrorist attacks that may meet the resolution criteria. If the database is not maintained until 2030, we will search news articles to identify any relevant attacks.

Historical Base Rate Data

- In the last 20 years, there have been two attacks that would clearly meet the resolution criteria:
    - 2019 Pulwama attack - A suicide bomber attack on a convoy of vehicles carrying Indian security personnel resulting in 41 deaths. Responsibility was claimed by the Pakistan-based terrorist organization, Jaish-e-Mohammed.
    - 2008 Mumbai attack - A series of attacks on Mumbai across four days, which resulted in 175 deaths. Responsibility was claimed by Lashkar-e-Taiba, a Pakistan-based terrorist organization.
- There are some attacks that killed more than 30 people where it is unclear whether India blame a Pakistan-based group:
    - 2005 Delhi bombings - The incident killed 62 people. The Pakistani Islamist terrorist group Lashkar-e-Taiba claimed responsibility, but it is unclear if the Indian government confirmed this or blamed this group.
- There have also been several other attacks that have killed between 10 and 30 people, that have been blamed on Pakistan-based terrorist groups (source: the Global Terrorism Database)
    - 2017 Pulwama - killed 11
    - 2016 Uri - killed 24
    - 2016 Pathankot - killed 12
    - 2014 Mohara - killed 17
    - 2014 Arnia - killed 11
    - 2008 New Delhi - killed 13
    - 2007 New Delhi - killed 13
    - 2006 Doda - killed 22

Other Helpful Information

- The Pulwama Crisis: Flirting With War in a Nuclear Environment - Moeed W. Yusuf, Arms Control Association
- Conflict Between India and Pakistan - The Center for Preventative Action

Entanglement: What is the probability that, on January 1st 2030, a designated panel of experts will agree that:

a) Conventional and nuclear weapons and C3I systems are significantly more intertwined than they were on January 1st 2024?
b) Nuclear weapons and nuclear C3I systems are significantly more vulnerable to non-nuclear threats than they were on January 1st 2024?

Resolution Criteria

- We will recruit a panel of at least five experts with relevant expertise and ask them whether they agree with the statements. The question will resolve as positive if a majority of the panel answers 'yes'.
- a) The panel will be asked to consider the following:
    - The degree of geographical proximity between nuclear and conventional forces
        - This includes storage used for both conventional and nuclear warheads, co-locations of nuclear and nonnuclear delivery systems, or the positioning of nuclear and conventional forces in proximity during conflict.
    - The degree of integration of command and control systems for nuclear and conventional weapons
        - This might be evidenced by more states (following the example of the US and Russia) officially declaring that they will consider an attack on their C3I systems (which are used for both conventional and nuclear weapons) as an attack on their nuclear capabilities.
    - The degree of overlap in missiles and delivery systems for nuclear and conventional weapons, e.g.:
        - The development of conventional re-entry vehicles for delivery systems that currently are exclusively deployed with nuclear missiles. For instance, hypersonic glide vehicles with conventional warheads are developed to be deployed on delivery systems for intercontinental ballistic missiles and/or submarine-launched ballistic missiles.
        - Allowing a missile to be fitted with conventional *as well as* nuclear warheads that previously had only a conventional *or* nuclear option.
        - The development of a new delivery system, or the development of a new, superficially indistinguishable variant for an existing delivery system, resulting in a delivery system that could be equipped with either a conventional or a nuclear weapon. Examples: The US air-launched cruise missile AGM-86 has nuclear and conventionally equipped variants that are virtually indistinguishable, and Russia's air-launched ballistic missiles Kinzhal and Kh-101/Kh-102 can carry both conventional and nuclear warheads.
- b) The panel will be asked to consider the following:
    - The extent of improvement in accuracy and range of nonnuclear missiles, including ballistic and cruise missiles, and hypersonic glide vehicles (HGV). This includes:

        - The widespread availability of missiles that could effectively deliver a nonnuclear payload to silo-based and/or road-mobile ICBMs.
        - The ability of missiles or HGVs to reach C3I assets, such as early-warning satellites (which are especially vulnerable due to their low orbits and numbers; US possesses 14, Russia 5 (+5 planned) and China at least 3 satellites).
    - The extent to which nuclear C3I systems become more vulnerable to cyberattacks, for example due to:
        - The modernization of old, but easy-to-defend digital systems.
        - An increase in shared software components for different C3I assets.
    - The extent to which advances in data analytics have increased the vulnerability of nuclear weapons to nonnuclear attacks.
        - E.g. by enhancing the ability to detect mobile missiles, SSBNs and other vulnerable assets.

Historical Base Rate Data

a) Examples of conventional and nuclear forces being intertwined as of January 2024
    - Nuclear C3I systems of US, Russia and China use dual use assets and are vulnerable to conventional attacks. (Sources: James Acton on C3I entanglement, NC3 systems and inadvertent risk)
    - Dual-use delivery systems and missiles:
        - Nuclear bombs are usually deployed by dual capable aircrafts (DCA).
        - ICBM
            - ICBMs are generally capable of deploying both conventional and nuclear missiles, but have (so far) been only equipped with nuclear missiles.
            - Russia's Avangard is a hypersonic glide vehicle officially introduced in 2018 that is reported to be able to carry a nuclear or a conventional payload.
            - The Russian ICBM Sarmat can reportedly carry nuclear missiles and glide vehicles.
            - US programs are developing conventional warheads capable of attacking targets around the world within an hour. This likely leads to conventional missiles deployed from platforms currently used for strategic nuclear missiles, such as ICBMs and SLBMs. (source)
        - Air-launched cruise missile (ALCM)
            - US: AGM-86 has nuclear and conventional equipped variants.
        - Air-launched ballistic missile (ALBM)
            - Russia: Kinzhal, Kh-101/Kh-102 can carry conventional and nuclear warheads.
        - Sea-launched cruise missiles (SLCM)
            - Russia: Moskit, Bazalt, Granat, and others have conventional and nuclear warheads available.
        - Intermediate-range missile (IRM)

- China's DF-26 can reportedly carry a nuclear or a conventional warhead.

b) Examples of conventional threats to nuclear forces as of February 2024
   - Conventional weapons with high precision, stealth capabilities and quick delivery speeds that can threaten strategic forces such as silo-based ICBMs. (Source: Nuclear Reset: Arms Reduction and Nonproliferation, p.432, Nuclear Proliferation: new technologies, weapons, treaties, p. 85-103)
     - This includes guided air bombs, air-to-surface guided missiles and long-range cruise missiles (e.g. Tomahawk SLCM).
   - C3I assets are vulnerable to cyberattacks. (Source)
   - Maneuverable satellites pose a threat to other satellites, such as those used in earl-warning systems, by throwing them out of their orbits or damaging them, for example by provoking a crash. (Source)

Other Helpful Information

- Considerations regarding entanglement include:

a)
   - An attack with a weapon system capable of deploying both conventional and nuclear missiles might be falsely interpreted as a nuclear attack and be retaliated as such. Conventional and nuclear missile types might be indistinguishable on detection systems such as radar and thus provoke a reaction as if attacked with the nuclear version. (Sources: expert interviews, physicians for social responsibility)
   - An attack on a dual use system can be perceived as an attack on nuclear capabilities even if the target was chosen for its conventional capabilities, and be retaliated with nuclear force. (Source: expert interviews)
     - For example, the US and Russia have declared to consider using nuclear weapons to retaliate an attack on its early-warning satellites (C3I systems), which are used to detect nuclear as well as nonnuclear attacks. (Sources: Carnegie Endowment, Nautilus)
   - In the case of geographical closeness of nuclear and conventional assets, an attack targeted at conventional assets could affect the nuclear assets as well, or be interpreted as an attack on nuclear capabilities. (Source)
   - Expanding nuclear deterrence to other "significant" attacks, such as ballistic missile attacks, chemical, biological, or cyber attacks, is argued to increase deterring such attacks, serving deterrence objectives otherwise unachievable. But it could also increases the probability of nuclear first use. (Sources: "Blurring the Lines: Nuclear and Conventional Deterrence", Watkins, "Conventional-Nuclear Integration to Strengthen Deterrence", Horschig, Adamopolous)
   - Kroenig and Massa point out that dual-capable systems have been used without resulting in nuclear war and that they might contribute to deterrence.

b)

- A heightened vulnerability of nuclear forces to conventional weapons enhances the possibility of a surprise attack by a smaller, new nuclear power against another. (Source)
- The ability to threaten nuclear forces with conventional weapons undermines nuclear deterrence. (Sources: Nuclear Proliferation: new technologies, weapons, treaties p. 99, Chinese concerns, p. 160)
  - States could be more likely to use their nuclear forces if convinced that their second strike capabilities were threatened by conventional means.
  - Conventional forces capable of destroying nuclear assets enable attacks on nuclear forces without striking with nuclear weapons first, though such attacks are expected to be retaliated with nuclear force.
- The likelihood of conventional strikes unintentionally destroying nuclear assets increases with the capability of conventional forces.

Democracy: What is the probability that, on January 1st, 2030, the most recent score on the V-Dem Liberal Democracy Index for [x] will be 0.03 units [higher / lower] than its 2022 score?

a) China [higher]
b) North Korea [higher]
c) India [higher]
d) Pakistan [higher]
e) Russia [higher]
f) The USA [lower]

Resolution Criteria

- The central estimate of the liberal democracy index of the V-Dem Dataset will be used to resolve the question. This index "combines information on voting rights, the freedom and fairness of elections, freedoms of association and expression, civil liberties, and executive constraints. It ranges from 0 to 1, with 0 indicating a minimally democratic state and 1 indicating a maximally democratic state. (Source)
- For example, the central estimates of the liberal democracy index for countries around the world for 2022 can be found on the *Our World in Data* website here.
- The V-Dem democracy index measures 600+ indicators and uses estimates by 3,700+ experts for all countries. The V-Dem Dataset has been published annually since 1789. (Source)
- The 2022 estimates for the countries were:
  - a) In 2022, China had a central estimate of **0.04** units on its V-Dem's liberal democracy index. (Source) The question will resolve positively if the central estimate for China's V-Dem's liberal democracy index for 2030 is **0.07** units or higher. The most recent version of the V-Dem dataset available on January 1st 2030 will be used to resolve this question, as long as the latest available dataset version was published in 2028 or subsequent years. If the most recent available dataset predates 2028, the question will resolve as ambiguous.

- b) In 2022, North Korea had a central estimate of **0.01** units on its V-Dem's liberal democracy index. (Source) The question will resolve positively if the central estimate for North Korea's V-Dem's liberal democracy index for 2030 is **0.04** units or higher. If a V-Dem Dataset for 2030 is not available by the end of 2031, the question will resolve as ambiguous.
- c) In 2022, India had a central estimate of **0.31** units on its V-Dem's liberal democracy index. (Source) The question will resolve positively if the central estimate for India's V-Dem's liberal democracy index for 2030 is **0.34** units or higher. If a V-Dem Dataset for 2030 is not available by the end of 2031, the question will resolve as ambiguous.
- d) In 2022, Pakistan had a central estimate of **0.26** units on its V-Dem's liberal democracy index. (Source) The question will resolve positively if the central estimate for Pakistan's V-Dem's liberal democracy index for 2030 is **0.29** units or higher. If a V-Dem Dataset for 2030 is not available by the end of 2031, the question will resolve as ambiguous.
- e) In 2022, Russia had a central estimate of **0.07** units on its V-Dem's liberal democracy index. (Source) The question will resolve positively if the central estimate for Russia's V-Dem's liberal democracy index for 2030 is **0.10** units or higher. If a V-Dem Dataset for 2030 is not available by the end of 2031, the question will resolve as ambiguous.
- f) In 2022, the United States had a central estimate of **0.74** units on its V-Dem's liberal democracy index. (Source) The question will resolve positively if the central estimate for the United States' V-Dem's liberal democracy index for 2030 is **0.71** units or lower. If a V-Dem Dataset for 2030 is not available by the end of 2031, the question will resolve as ambiguous.

Historical Base Rate Data

This table shows the V-Dem's liberal democracy indices of China, Russia, the US, India, Pakistan and North Korea for the years 2017-2022.

	China	**Russia**	**US**	**India**	**Pakistan**	**North Korea**
***2022** score*	0.04	0.07	0.74	0.31	0.26	0.01
***2021** score*	0.04	0.10	0.73	0.33	0.27	0.01
***2020** score*	0.04	0.10	0.72	0.31	0.27	0.01
***2019** score*	0.04	0.11	0.72	0.33	0.25	0.01
***2018** score*	0.05	0.11	0.73	0.37	0.27	0.01

***2017** score*	0.05	0.11	0.74	0.38	0.27	0.01

***Table A16:** V-Dem's liberal democracy index scores for China, Russia, the US, India, Pakistan and North Korea, 2017-2022.*

Vertical proliferation: What is the probability that, on January 1st, 2030, the most recent data from the Federation of American Scientists will report that the total number of nuclear warheads globally is greater than 15,000?

Resolution Criteria

- This question will resolve using data released by the Federation of American Scientists (FAS) on the total number of warheads globally. This includes deployed strategic warheads, deployed nonstrategic warheads, reserve/nondeployed warheads, and retired warheads that are earmarked for dismantlement. The data can currently be found here on the FAS website.
- As of January 2024, the total number of nuclear warheads globally is estimated at ~12,512. For the question to resolve positively, the number must increase to over 15,000 by January 1st, 2030.
- In the event the FAS discontinues reporting or changes its reporting methodology making direct comparison impossible, credible alternative sources may be considered by an expert panel.
- If the resolution is ambiguous, it will be resolved by a panel of experts.

Historical Base Rate Data

Country	Total number of warheads in military stockpile
Russia	5,889
United States	5,244
France	290
China	410
United Kingdom	225
Israel	90
Pakistan	170
India	164
North Korea	30

Total	~12,512

Table A17: *Estimated number of deployed strategic nuclear weapons by country, 2023. Source: Federation of American Scientists, Status of World Nuclear Forces. Accessed: January 24th, 2024.*

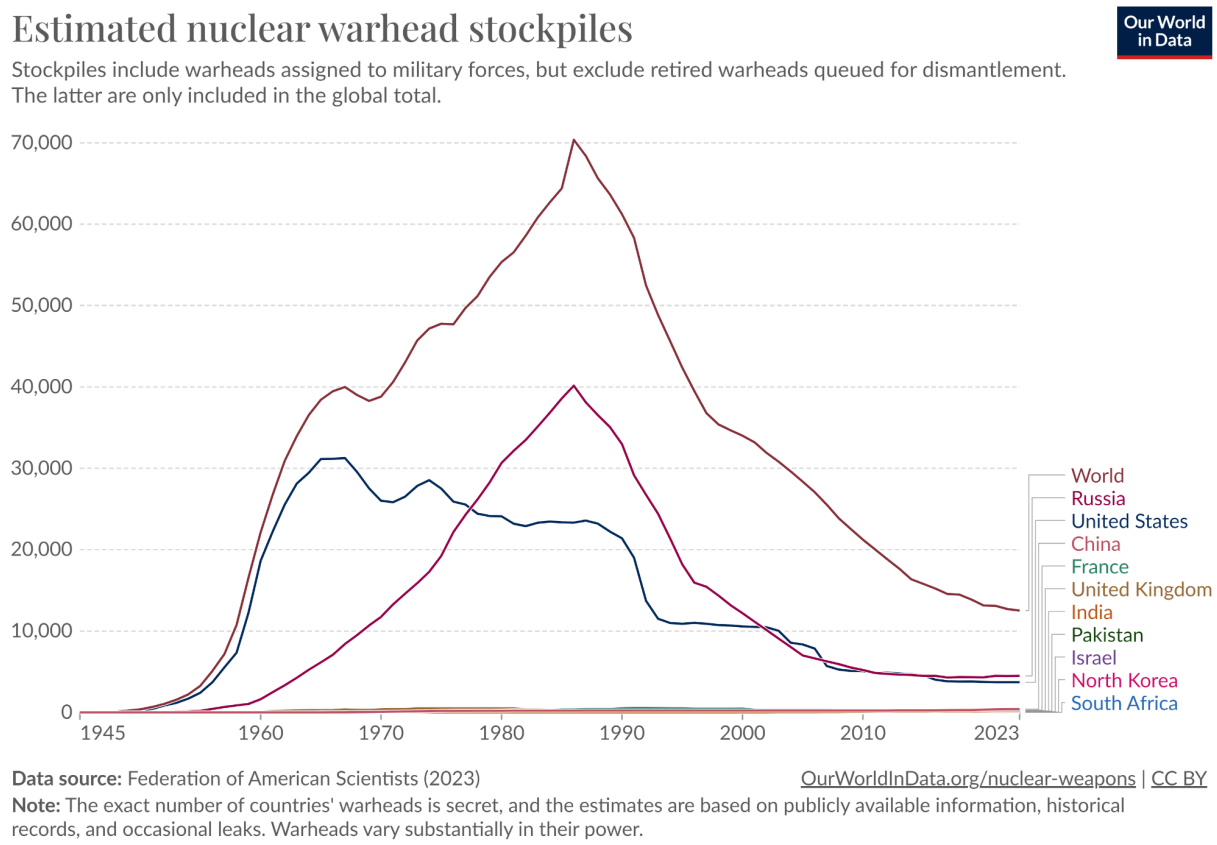

Figure A7: *Total number of nuclear warheads since 1945. Source: Federation of American Scientists via Our World in Data.*

Other Helpful Information

- Bulletin of Atomic Scientists: Nuclear Arsenals of the World (Collection of Nuclear Notebooks)
    - US Notebook 2023
    - Russia Notebook 2023
    - China Notebook 2024
    - North Korea Notebook 2022
    - India Notebook 2022
    - Pakistan Notebook 2023
    - France Notebook 2023
    - Israel Notebook 2022
    - UK Notebook 2021
- Nuclear Notebook 2009: Worldwide Deployments of Nuclear Weapons, 2009
- Nuclear Notebook 2014: Worldwide deployments of nuclear weapons, 2014

- Nuclear Notebook 2017: Worldwide deployments of nuclear weapons, 2017
- The footnotes on the FAS *Status of World Nuclear Forces 2023* report are useful.

Arms control agreements: What is the probability that, by the 1st of January, 2030, [x] will have signed an agreement which limits the number or location of nuclear-capable delivery systems (e.g., launchers, bombers) or nuclear warheads?

a) China and the USA
b) Russia and the USA or NATO
c) India and Pakistan
d) North Korea and South Korea or the USA

Resolution Criteria

- It is not necessary that the agreement imposes bilateral limits on these items: an agreement which does not impose such restrictions on one party but does impose such restrictions on the other party would qualify.
    - An agreement involving actors aside from these named parties (e.g., a trilateral agreement) would qualify, so long as the agreement imposes qualifying restrictions on either party.
    - Unilateral pledges that do not stem from mutually signed agreements, however, do not qualify.
- It is not necessary that either state ratify such an agreement, although at least one side must take meaningful initial steps to implement the agreement.
    - For example, if the United States and Russia signed an agreement that would involve reducing a qualifying aspect of their arsenal and they both begin this process, it would qualify even if the countries do not finish implementing the agreement before one or both countries withdraw from the agreement..
    - In contrast, if the United States and Russia signed an agreement that would involve eliminating parts of their arsenals, but the deal is almost immediately derailed and neither side has begun disassembling or destroying weapons in line with the agreement, this would likely be judged as not qualifying.
    - Serious ambiguities around “meaningful initial steps” will be resolved by a panel of experts.
- It is not necessary that the agreement be fully honored, so long as one side takes initial steps to implement the agreement.
- The agreement need not be publicly acknowledged by either government, but credible media outlets must affirm that the countries have signed an explicit agreement with terms relating to nuclear-capable delivery systems or nuclear warheads.
- Extensions of previous treaties that were scheduled to end before 2030 would qualify.
- Restrictions on space-based systems would qualify.

China and the USA

Historical Base Rate Data

- China has signed or abided by some non-proliferation agreements, but these kinds of agreements **would not qualify for the question criteria**. For example:
    - China signed the Nuclear Nonproliferation Treaty (NPT) in 1968. (Source)
    - China "has agreed to apply" the Missile Technology Control Regime (MTCR) in 1987, but it is not a formal member. (Source)
- The United States has signed a wide range of arms control agreements that would qualify for this question with countries other than China. For example, there have been at least eight agreements between the US and Russia that would have fit the resolution criteria (setting aside time period) since 1962. (For more details, see the Council on Foreign Relations' timeline of US-Russia nuclear arms control.)
- The US and China have not signed an agreement between each other that would impose qualifying limits.

Other Helpful Information

- China is in the midst of nuclear modernization and buildup that has worried some Western analysts. The United States is also planning to modernize its nuclear arsenal.
- According to Reuters, in 2023, "The U.S. and China held their first talks on nuclear arms control in nearly five years on Nov. 6, amid growing U.S. concerns about China's nuclear build up, but the meeting produced no specific results."
- Some scholars claim that US–China negotiations on nuclear weapons have been hampered by disagreements or demands around various issues, such as the Chinese insistence that the United States should acknowledge "mutual vulnerability" and that given China's small arsenal, they should not have to make many concessions.
    - "To date, China has showed exactly zero interest in any such process, and with good reason. When the issue of the buildup is raised, experts are quick to point out the United States has many more such weapons than China, a point that China reinforces in its own propaganda." (Source)

Russia and the USA

Historical Base Rate Data

- There have been at least eight agreements between the US and Russia that would have fit the resolution criteria (setting aside time period) since 1962:
    - 1962: The Cuban Missile Crisis occurs, followed by secret agreement from both sides to withdraw or not deploy missiles in areas (e.g., US missiles in Turkey). (Source)
    - 1972: The US and the Soviet Union sign the SALT I Interim Agreement, which "froze each nation's intercontinental ballistic missiles (ICBMs) and submarine-launched ballistic missiles (SLBMs) levels for five years." (Source)
    - 1979: The US and the Soviet Union sign SALT II, which "would have placed further limits on their nuclear weapons and launch platforms, including strategic bombers," but when the Soviets invade Afghanistan later that year, the US declines to ratify the treaty. However, because the two parties signed the agreement and various sources suggest that "both states honored the terms of

the agreement" even without officially ratifying it, **this agreement would qualify for the forecasting question criteria (assuming that a panel of experts agreed).**
    - 1987: The US and the Soviet Union sign the Intermediate-Range Nuclear Forces (INF) Treaty, which involves the elimination of the countries' "ground-launched, midrange nuclear missiles." (Source)
    - 1991: The US and the Soviet Union sign the START treaty, through which the countries "pledge to reduce their arsenals to well below six thousand by 2009." (Source)
    - 2002: The US and Russia sign the Strategic Offensive Reductions Treaty, which was a loosely worded agreement to reduce deployed arsenals. (Source)
    - 2010: The US and Russia sign New START, which commits the countries to "another round of cuts to their strategic offensive arsenals." (Source)
    - 2021: The US and Russia agree to extend New START. (Source)
- For context and clarification, some agreements between the US and Russia that may be relevant to the likelihood of nuclear weapons negotiations but would not qualify include:
    - 1963: The US and the Soviet Union agree to the Limited Test Ban Treaty (and a "hotline"). (Source)
        - This does not qualify for the question criteria because it does not cover relevant aspects of arsenals.
    - 1968: The US and the Soviet Union sign the Treaty on the Nonproliferation of Nuclear Weapons (NPT). (Source)
        - This does not qualify for the question criteria because it does not cover relevant aspects of arsenals.
    - 1972: The US and the Soviet Union sign the Anti-Ballistic Missile (ABM) Treaty, which "limits the countries' deployment of missile defense systems to their national capital and one ICBM site." (Source)
        - This does not qualify for the question criteria because it does not cover relevant aspects of arsenals.
    - 1993: The US and Russia sign START II, "which aims to limit the number of strategic nuclear weapons that the parties can hold," but it never comes into effect (despite being ratified in the US Senate and conditionally ratified in the Russian Duma). (Source)
        - Although the two parties signed the agreement, sources suggest that it was never meaningfully implemented. Insofar as this is correct, **it would likely not qualify for the forecasting question criteria**.
    - 1997: The US and Russia sign a joint statement that would amend the ABM Treaty, but the US Senate never ratified it and in 2001 the US announced that it would withdraw from the treaty. (Source)
        - This does not qualify for the question criteria, not only because it was not meaningfully implemented but also because it did not relate to relevant weapon deployment/limits.

Other Helpful Information

- In 2023, Russia “suspended” its participation in the information exchange required by New START, but Russian officials claim they will continue to abide by the limits on the “numbers of deployed long-range nuclear forces.” (Source)
- Russian officials have recently said that resuming negotiations on nuclear arms control is “unacceptable” given ongoing US support for Ukraine. (Source)

India and Pakistan

Historical Base Rate Data

- No prior agreements that would qualify for the criteria of this question were found, but the Arms Control Association provides the following list of other agreements between India and Pakistan relevant to weapons of mass destruction:
    - “India-Pakistan non-Attack Agreement, entered into force in January 1991.” (Source)
    - “In 1992 India signed the India-Pakistan Agreement on Chemical Weapons for the ‘complete prohibition of chemical weapons.’” (Source)
    - “After their tit-for-tat nuclear tests in 1998, Pakistan and India volunteered to abstain from nuclear testing.” (Source)
    - “Established a hotline to reduce the risk of accidental nuclear war and agreed to exchange advance notifications of ballistic missile flight tests.” (Source)
    - “In 2007, the fifth round of talks regarding the review of nuclear and ballistic missile-related confidence-building measures took place as part of the Composite Dialogue Process.” (Source)
    - “Talks have stalled since 2019 over tensions in Kashmir, though the U.S. has supported Pakistani efforts to resume dialogue.” (Source)

Other Helpful Information

- For a summary and discussion of the India-Pakistan nuclear situation, see “Nuclear weapons at a glance: India and Pakistan” (House of Commons Library).

North Korea and South Korea

Historical Base Rate Data

- The following is a non-exhaustive list of agreements that very likely would have qualified for this question:
    - 1992: South Korea and North Korea issue the Joint Declaration of the Denuclearization of the Korean Peninsula. (Source)
    - 1994: The US and North Korea sign the Agreed Framework. (Source)
- For context and clarification, these are some past agreements which may be relevant when thinking about the prospects of negotiations but very likely would not have qualified for the question criteria:
    - The 2018 Pyongyang Joint Declaration would not qualify for the question criteria because it is not specific with regard to qualifying actions (e.g., arsenal reduction).

    - The 2023 agreement between the United States and South Korea, wherein South Korea agreed not to develop nuclear weapons, would not qualify for the question criteria because it does not include North Korea.

Other Helpful Information

- "In 2003, North Korea withdrew from the Nuclear Non-Proliferation Treaty and then tested its first nuclear weapon on October 9, 2006. It continues to build its stockpile of nuclear weapons, test short- and medium-range ballistic missiles, and produce fissile material." (Source)
- For details on North Korea's nuclear arsenal, see: Nuclear Notebook: How many nuclear weapons does North Korea have in 2022? (Bulletin of the Atomic Scientists)
- For chronologies and other overviews of the history of nuclear negotiations with North Korea, see:
    - Nuclear Negotiations with North Korea (Congressional Research Service)
    - Chronology of U.S.-North Korean Nuclear and Missile Diplomacy, 1985-2022 (Arms Control Association)
    - Timeline: North Korean Nuclear Negotiations (Council on Foreign Relations)

Horizontal proliferation: What is the probability that [x] conducts a nuclear weapons test or comes into possession of nuclear weapons before the 1st of January 2030?

a) Iran
b) Any state other than Iran, that is not currently believed to have nuclear weapons
c) A non-state actor

Resolution Criteria

- Question a) will resolve positively if the Federation of American Scientists (FAS) estimates that Iran, obtains or develops at least one nuclear warhead between January 2024 and January 1st 2030, or if the CTBTO (Comprehensive Nuclear-Test-Ban Treaty Organization) reports that the IMS (International Monitoring System) detected a nuclear detonation within the borders of Iran and this detonation is not claimed by a non-state actor or other state.
- Question b) will resolve positively if the FAS estimates that any state, other than Iran, that is not a current nuclear state, obtains or develops at least one nuclear warhead between January 2024 and January 1st 2030 or if the CTBTO reports that the IMS detected a nuclear detonation within the borders of a state that is not a current nuclear state or Iran and this detonation is not claimed by another actor.
- Question c) will resolve positively if the FAS or—as non-state actors may not be included in the FAS dataset—at least three reputable media outlets, report that a non-state actor is in possession of a nuclear warhead, or if the CTBTO reports that the IMS detected a nuclear detonation.
    - A 'non-state actor' refers to any individual, group, or organization that is not recognised as an official nation-state by the United Nations or a UN General Assembly non-member observer state (which, at the time of writing, includes only

the Holy See and the State of Palestine). Examples of non-state actors include, but are not limited to, terrorist organizations, private militias, and independent actors.
- For each of these questions, if the relevant actor obtains or develops at least one nuclear warhead within that time, but ceases to possess at least one nuclear warhead at time of resolution, the question will also resolve positively.
- Radiological dispersal devices ("dirty bombs") do not count towards a positive resolution of this question.
- For resolution of this question, we will use the updated version of the FAS dataset or an equivalent dataset that is agreed to be credible by a panel of experts. If such a dataset is not available, the question will be resolved by a panel of experts.

Iran

Historical Base Rate Data
Historical overview of Iran's development of nuclear capabilities and efforts to avert Iran acquiring nuclear weapons, including sanctions and negotiations. (Sources: Country profile of Iran, Nuclear Threat Initiative; Nuclear Power in Iran, World Nuclear Association)

- *1950s-2002 Development of the Iranian nuclear program and nuclear cooperation*
    - 1950s: Iran begins its development program
    - 1967: the US supplies Iran with a small 5MWt research reactor (TRR)
    - Up to 1979: Iran develops nuclear capability technologies
    - 1979-1984: Iran's nuclear program nearly disintegrates
    - 1987 and 1990: Nuclear cooperation agreements with Pakistan and China (including personnel training and several reactors)
    - 1992, 1995: Bilateral nuclear cooperation agreements with Russia
    - 1989-2003: US pressured suppliers to limit their nuclear cooperation with Iran, resulting in China not supplying Iran with several reactors and a uranium conversion plant, Boris Yeltsin agreeing to limit Russia's nuclear cooperation with Iran and the blocking of an agreement with Argentina
    - 2002: National Council of Resistance of Iran (NCRI) reveals the existence of undeclared nuclear facilities in Iran
- *2003-2013 Negotiations and sanctions*
    - 2003: Iran agrees to cooperate with the IAEA and to sign the Additional Protocol
    - 2004: IAEA discovers hidden documents which are first dismissed as forgeries and later admitted to be authentic; Iran concludes the Paris Agreement
    - 2003-2004: Iran continues to produce centrifuge components and carry out small-scale conversion experiments
    - 2005: US order sanctioning WMD proliferation support is signed, including the financial assets of four Iranian entities
    - 2006: Iran ceases to voluntarily implement the Additional Protocol, resumes uranium enrichment and inaugurates a heavy water production plant
    - 2006-2008: United Nations Security Council (UNSC) passes three resolutions (1696, 1737, 1835) sanctioning Iran's nuclear activities, freezing assets and banning international trade of nuclear and missile technologies

    - 2009: Iran discloses the construction of a second pilot enrichment facility; negotiations between Iran and P5+1 (France, Germany, UK, US, China and Russia) fail
    - 2010: Stuxnet cyberattack on Iranian organizations damages its nuclear program, for which the US and Israel are widely recognized as responsible; further sanctions (UNSC resolution 1929)
    - 2010-2011: negotiations between Iran and P5+1 (France, Germany, UK, US, China and Russia) fail
    - 2012: Further sanctions against Iran (US order to freeze Iranian government properties, Iran Threat Reduction Law, Menendez Kirk amendment), another round of negotiations between Iran and P5+1 fails
    - 2013: US expands sanctions against Iran
- *2015-2024: Recent developments*
    - 2015: P5+1 States and Iran sign the Joint Comprehensive Plan of Action (JCPOA)
    - Since 2016: IAEA releases quarterly verification and monitoring reports on Iran's implementation of the JCPOA
    - 2018: President Trump announces that the United States would retract from JCPOA and reimpose sanctions on Iran
    - 2019-2020: Iran gradually reduces its compliance with JCPOA, but continues to cooperate with IAEA inspections of sites related to the JCPOA, but not other sites
    - 2021-2022: IAEA reports Iran has resumed enriching uranium up to 60%
    - 2023: France, Germany, UK and US call on Iran to comply with its legally-binding international obligations; Iran agrees to enhance its cooperation with IAEA

Other Helpful Information

- Deciphering Iran's Nuclear Strategy, Ariel (Eli) Levite, Carnegie Endowment for International Peace, 2021
- What Is the Iran Nuclear Deal?, Kali Robinson, Council on Foreign Relations, 2023

Any State other than Iran

Historical Base Rate Data

Timeline of nuclear weapons development by country (sources: I II III IV V VI VII VIII IX X)

- US
    - 1939 - beginning of development program
    - 1945 - first successful test
- USSR
    - 1942 - beginning of development program
    - 1949 - first successful test
- UK
    - 1940 - beginning of development program
    - 1952 - first successful test
- France

    - 1956 - beginning of development program
    - 1960 - first successful test
- China
    - 1954 - beginning of development program
    - 1964 - first successful test
- India
    - 1967 - beginning of development program
    - 1974 - first successful test
- Israel
    - 1948 - Estimated date of development program
    - 1963 - Possible date of first successful test
    - 1979 - Possible date of first successful test (Vela Incident)
- Pakistan
    - 1972 - beginning of development program
    - 1998 - first successful test
- North Korea
    - 1980s - beginning of development program
    - 2006 - first successful test

Other Helpful Information

- Countries profiles, Nuclear Threat Initiative
- Nuclear Weapons: Who Has What at a Glance, Arms Control Association, 2023

Non-state Actors

Historical Base Rate Data

- To date, there has been no confirmed instance of a non-state actor (as defined by the resolution criteria) coming into possession of a nuclear weapon.
- While no non-state actor has successfully come into possession of a nuclear weapon, there have been several reports of non-state actors *attempting* to come into possession of a nuclear weapon:
    - The Japanese terror cult Aum Shinrikyo, responsible for the 1995 Tokyo Sarin Subway attack, allegedly tried to procure nuclear weapons in the 1990s. There is no indication that they ever were able to procure nuclear weapons.
    - NBC reported in 2015 that the Islamic State of Iraq and Syria (ISIS) attempted to purchase radioactive materials from gangs with Russian connections. Several other reports have indicated that ISIS had ambitions to procure nuclear materials.
        - The Independent: Brussels attacks: Belgium fears Isis seeking to make 'dirty' nuclear bomb
        - The Independent: Nato warns there is 'justified concern' Isis will carry out nuclear attack in Europe
    - Numerous reports suggest that the pan-Islamist militant terror organization Al-Qaeda has tried to acquire fissile material to construct a nuclear device on multiple occasions. All available reports suggest that these attempts have been

unsuccessful, that Al-Qaeda lacks the technical expertise to actually assemble a nuclear weapon, and, even with sufficient fissile material, that it is unlikely to acquire a nuclear device without significant support from nuclear scientists.
    - Does Intent equal Capability? Al-Qaeda and Weapons of Mass Destruction, Sammy Salama, Lydia Hansell, 2007
    - Reevaluating Al-Qa`ida's Weapons of Mass Destruction Capabilities, Peter Bergen, 2010
    - Al Qaeda's Pursuit of Weapons of Mass Destruction, Rolf Mowatt-Larssen, Foreign Policy, 2010 (archived)

No-first-use: What is the probability that [x] has a no-first-use policy on January 1st, 2030?

a) China
b) India
c) Russia
d) Pakistan
e) North Korea
f) The USA

Resolution Criteria

- This question resolves positively if, on the 1st of January 2030, the state has a 'no-first-use' (NFU) policy in place. This means that the state declares that they would not use nuclear weapons unless they were using them in response to nuclear weapons being used by an adversary against the state or an ally of the state. This includes having no exceptions to its NFU policy, for example reserving the option of first use in response to biological, chemical or cyber attacks, or excluding nuclear-armed states in its NFU doctrine.
- The NFU policy must be officially adopted by the government of the state, and could be implemented and confirmed through various channels. For instance, for the USA, confirmation could (but would not necessarily) refer to an Executive Order issued by the President of the United States, an official policy document released by the United States Department of Defence, or a law.
- If the resolution is ambiguous, it will be resolved by a panel of experts.

Historical Base Rate Data

As of March 2024, only China and India maintain a NFU policy. States other than India, China and the Soviet Union have historically not been considered to have a policy of NFU. (Source)

Year	Event	Notes
1964	• China adapts a NFU policy	• China has maintained its NFU policy to the present, though some suggest a softening of this stance in 2023.

1982	• Public pledge that the Soviet Union would abide by NFU	• The pledge was made by Leonid Brezhnev. General Secretary of the Communist Party of the Soviet Union. • Western sources did not see the pledge as credible. • Russia has not held a NFU policy since 1993.
2003	• India adapts a NFU policy (debated)	• The exact year is debated. • India's 2003 NFU policy has exceptions for attacks with "biological or chemical weapons" and would not qualify for this question.

Table A18: *Historical overview of adaptations of NFU policies, 1945-2023.*

China

Historical Base Rate Data

- China has maintained a no-first-use policy from 1964 to the present, although some commentators have suggested that China softened their stance in 2023.

Other Helpful Information

- Royal United Services Institute: China's No First Use of Nuclear Weapons Policy: Change or False Alarm?

India

Historical Base Rate Data

- The exact year of its adoption of any form of a "no-first-use" policy is debated: some analysts consider India to have first adopted a form of NFU in 2003. However, India's 2003 NFU policy had exceptions for attacks with "biological or chemical weapons," which would not qualify for the purposes of this question.

Other Helpful Information

- India Global Business: Much Ado About India's No-first-use Nuke Policy - Carnegie Endowment for International Peace
- "India conducted its first nuclear explosive test in 1974," and did not conduct another test until 1998.

Russia

Historical Base Rate Data

- In 1982, Leonid Brezhnev publicly pledged that the Soviet Union would abide by NFU, but many Western sources did not see it as credible, and Western analysts later acquired Soviet military documents that they claim demonstrate that the Russian military plans were to abandon NFU if hostilities broke out over Germany. (Source)
- Russia has not held a public no-first-use policy since 1993. (Source)

Other Helpful Information

- Bulletin of the Atomic Scientists: Read the fine print: Russia's nuclear weapon use policy

Pakistan

Historical Base Rate Data

- Since becoming a nuclear weapon state in 1998, Pakistan has refused to adopt any form of a no-first-use policy. (Source)

North Korea

Historical Base Rate Data

- Since conducting its first nuclear test in 2006, North Korea has never given a firm no-first-use pledge. (Sources: NTI, 38 North, Asia-Pacific Leadership Network, and the Bulletin of the Atomic Scientists)

USA

Historical Base Rate Data

- The United States has never held a no-first-use policy and has repeatedly declined to declare a no-first-use policy even when prompted to consider such a policy by its nuclear posture reviews (NPRs), under both Democratic and Republican administrations. (Sources: CSIS, War on the Rocks, and the Arms Control Association)

SSBN reliability: On January 1st 2030, will the majority of a panel of experts agree that China, Russia, or the United States' nuclear missile submarine (SSBN) fleet has become significantly less reliable for second strike assurance than they were on January 1st 2024, due to improvements in detection/tracking technology?

Resolution Criteria

- We will recruit a panel of at least five experts with relevant expertise and ask them whether the SSBN fleet of any of the three countries is significantly less reliable for second strike assurance than it was in 2024. The question will resolve as positive if a majority of the panel answers 'yes'.
- The exact details of "significantly less reliable" may be subject to some interpretation, but this is intended to include outcomes such as "U.S. military experts are only 75% as confident as they were 5 years ago that their submarines provide second-strike assurance," while excluding outcomes such as "U.S. military experts are 95% as confident…"
- It would not be sufficient for a positive resolution if the countries' SSBN fleets merely have had to undergo improvements to maintain undetectability in the face of improving anti-submarine technology, but those improvements have been implemented.

- The specifics of the technological improvements or similar developments are generally not important for the resolution of the question (i.e., it need not be limited to detection/tracking technology), but decrease in assurance due primarily to factors such as a state collapsing or retiring its fleet (for reasons other than believing new technology has rendered it ineffective) would not qualify.
- Changes in future expectations of assurance would not qualify, even if the changes in future expectations occur before 2030. For example, it would not be sufficient for U.S. military leaders to declare in 2028 that they believe submarines will be significantly less reliable by 2035. A positive resolution requires a significant decrease in contemporary assurance.
- This question will be resolved by a panel of scholars convened at the beginning of 2030. The panel ruling will be determined by majority vote.

Other Helpful Information

- Some of the technologies that commentators have suggested might impact submarine detectability are discussed in this 2020 article by Sebastian Brixey-Williams and include:
    - Autonomous underwater and/or aerial vehicles
    - Improvements in sensor technology, including quantum sensing
    - Enhanced networks of sensors
    - Faster transmission of data underwater
    - Improved acoustics (potentially in combination with other technology)
- Open source data has also been suggested as another factor contributing to SSBN detection.
- Details about countries' submarine fleets:
    - United States: "United States Submarine Capabilities" (Nuclear Threat Initiative)
    - Russia: "Russia Submarine Capabilities" (Nuclear Threat Initiative)
    - China: "China Submarine Capabilities" (Nuclear Threat Initiative)
        - See also: "The Survivability of China's SSBNs and Strategic Stability" (Carnegie Endowment)
- Examples of expert commentaries on prospects of SSBN detection:
    - In 2012, Dr. James Clay Moltz wrote that "Particularly in the presence of emerging autonomous-tracking technologies, some of which are likely to be widely available within the next 20 years, these conditions raise the prospects for successful ASW against U.S. forces." (Source)
    - Pushing back on the warnings that American SSBNs may soon become detectable, in 2020 Matt Korda wrote: "Despite these actual technological breakthroughs on the U.S. side, ICBM advocates often focus on an opposing kind of breakthrough: the hypothetical kind, that would allow nuclear-armed adversaries to sink or disable U.S. boomers at sea. These fears appear to be exaggerated, in several key respects."
    - One analysis of future submarine detectability by the National Security College of Australian National University makes the following assessment: "the oceans are, in most circumstances, at least likely and, from some perspectives, very likely to become transparent by the 2050s. This suggests that, despite progress in

counter-detection technologies, SSBNs will be able to be detected in the world's oceans because of the evolution of science and technology."

US agreements - NATO: What is the probability that, by the 1st of January 2030, the US will have formally announced its intention to withdraw from NATO?

Resolution Criteria

- This question resolves positively if the United States officially announces its intention to withdraw from the North Atlantic Treaty Organization (NATO)
- For the question to resolve positively, the declaration of withdrawal must be clear, unambiguous, and officially communicated through channels such as a press release from the White House, the U.S. Department of State, the U.S. Department of Defense, or an official statement on the floor of the U.S. Congress. Reputable reports from at least two reputable international news organizations would also be sufficient for positive resolution of this question.
- The announcement must occur before January 1st, 2030. Discussions, debates, or proposals about withdrawal do not suffice; there must be a definitive and formal declaration of intent to withdraw.
- In the event of ambiguity or conflicting reports regarding the U.S.'s intention to withdraw from any of these agreements, the question will be resolved by a panel of experts.

Historical Base Rate Data

- NATO: No country has ever withdrawn from NATO. NATO was established in 1949 with 12 members and currently has 31 members. Table 1, showing a list of members and the year that each member joined NATO can be found below:

Country	Year of Accession
Belgium, Canada, Denmark, France, Iceland, Italy, Luxembourg, Netherlands, Norway, Portugal, United Kingdom, and the United States	1949
Greece and Turkey	1952
Germany	1955
Spain	1982
Czech Republic, Hungary, and Poland	1999
Bulgaria, Estonia, Latvia, Lithuania, Romania, Slovakia and Slovenia	2004
Albania and Croatia	2009

Montenegro	2017
North Macedonia	2020
Finland	2023

Table A19: *List of NATO members and the year of accession. Source: NATO, NATO member countries. Accessed 24th January, 2024, https://www.nato.int/cps/en/natohq/topics_52044.htm#coldwar2.*

- As of March 2024, the US is member to eight mutual defense treaties. It has annulled two, the Treaty of Alliance in 1798 and the Mutual Defense Treaty between the United States and the Republic of China (Taiwan) in 1980.

Year	Treaty
1778	• Treaty of Alliance (United States - France)
1798	• Treaty of Alliance, annulment
1947	• Inter-American Treaty of Reciprocal Assistance (Rio Treaty), ratification
1949	• North Atlantic Treaty (NATO), ratification
1951	• Mutual Defense Treaty (US - Philippines), signature • Australia, New Zealand, United States Security Treaty (ANZUS Treaty), formation
1954	• Mutual Defense Treaty (US - South Korea), ratification
1955	• Southeast Asia Collective Defense Treaty, ratification • Mutual Defense Treaty between the United States and the Republic of China (Taiwan), ratification
1960	• Treaty of Mutual Cooperation and Security between the United States and Japan, ratification
1979	• Taiwan Relations Act, ratification
1980	• Mutual Defense Treaty between the United States and the Republic of China (Taiwan), annulment
1986	• ANZUS - US suspends its treaty obligations to New Zealand

Table A20: *Years of ratification, signature or annulment of US defense treaties, 1778-2024.*

Figure A8: *Mapped: America's collective Defense Arrangements (2017).*

Other Helpful Information

- Donald Trump has at several occasions stated his intent to withdraw the US from NATO. (Source: Trump Will Abandon NATO, The Atlantic)

US agreements - JCPOA: Will the United States rejoin the JCPOA, or sign another treaty that restricts Iran's nuclear program, before January 1st, 2030?

Resolution Criteria

- The Joint Comprehensive Plan of Action (JCPOA), commonly known as the Iran nuclear deal, is a multinational agreement initially entered into by Iran, the United States, and other world powers for the purpose of regulating Iran's nuclear program in exchange for lifting economic sanctions.
- For the question to resolve positively, there must be an official announcement or statement from a relevant and authoritative body of the United States government, such as the President of the United States, the U.S. Department of State, or the U.S. National Security Council, confirming the decision to rejoin or recommit to the JCPOA, or the signature of a different agreement that restricts Iran's nuclear program agreement. The question will also resolve positively if either of these events are reported by at least two reputable international news organizations.

- The rejoining must involve the United States agreeing to the terms and conditions of the JCPOA as established in the original agreement or in a revised format that is mutually agreed upon by the original signatories, including Iran.
- A different agreement restricting Iran's nuclear program will be considered sufficient for resolving this question if it:
    - Requires Iran to limit the quantity of enriched uranium it holds and restricts the number of centrifuges (or any other type of uranium-enrichment technology) operational within its territory.
    - Requires Iran to permit regular and comprehensive inspections by the IAEA (or similar agency) to ensure its compliance with these limits.
    - Requires the US to lift some sanctions against Iran and includes details about the conditions under which sanctions would be reinstated, similar to the 'snapback' provision under the JCPOA.
- The re-entry into the JCPOA or the signature of the other agreement must be completed before January 1, 2030. Preliminary discussions, negotiations, or intentions to rejoin do not suffice; there must be a formal and definitive recommitment to the agreement.
- If the resolution is ambiguous, it will be resolved by a panel of experts.

Historical Base Rate Data

The JCPOA agreement was signed in 2015. In 2018, President Trump withdrew from JCPOA, reimposing sanctions on Iran. Negotiations to reinstall an agreement limiting Iranian activities related to the development of nuclear weapons have so far been unsuccessful.

Year(s)	Event
2002 - 2006	● Revelation of Iran's clandestine nuclear program, leading to international concern and sanctions
2006-2010	● UN Security Council imposes several rounds of sanctions on Iran
2013	● Moderate President Hassan Rouhani elected in Iran, initiates diplomatic overtures
2015	● JCPOA agreement reached between Iran and P5+1 (US, UK, France, Russia, China, and Germany)
2018	● US unilaterally withdraws from JCPOA under President Donald Trump, reimposes sanctions
2019	● Iran begins breaching JCPOA limits on uranium enrichment
2020	● Further escalations, including the assassination of Iranian General Qasem Soleimani
2021	● Negotiations to revive JCPOA under US President Joe Biden's administration

2022	• Negotiation appear to stall, US President Biden is captured on video saying that JCPOA is dead
2023	• The IAEA reports that Iran has increased its rate of production of enriched uranium. A joint statement is released by the US, France, Germany, and the UK condemning Iran for its increased production of enriched uranium.

Table A21: *Overview of major events related to Iran's nuclear program and the JCPOA agreement, 2002-2024.*

Prior Forecasts

- Metaculus: Will the US rejoin the Iran Nuclear Deal by 2024?
    - At the beginning of 2023, Metaculus forecasters gave an 8.1% probability that the US would rejoin the Iran nuclear deal by the end of 2023. This question resolved negatively.
- GJO: Before 1 July 2024, will the US, IAEA, and/or a UN agency publicly state that it believes it more likely than not that Iran possesses a nuclear weapon capable of being detonated?
    - Forecasters give this a 18.38% chance of resolving positively as of February 11th, 2024.

Other Helpful Information

- Council on Foreign Relations: What Is the Iran Nuclear Deal?
- Institute for Science and International Security: How quickly could Iran make nuclear weapons today?
- US government (joint statement with France, Germany, and the UK): Joint Statement on the Latest Iranian Nuclear Steps Reported by the IAEA
    - "The December 26, 2023 report by the IAEA highlights that Iran has increased its rate of production of uranium enriched up to 60% at Natanz and Fordow to levels observed between January and June 2023. These findings represent a backwards step by Iran and will result in Iran tripling its monthly production rate of uranium enriched up to 60%."

US agreements - ROK-US: What is the probability that, by the 1st of January 2030, the US will have formally announced its intention to withdraw from the ROK-US Security Treaty?

Resolution Criteria

- This question resolves positively if the United States officially announces its intention to withdraw from the Mutual Defence Treaty between the United States and the Republic of Korea.
- For the question to resolve positively, the declaration of withdrawal must be clear, unambiguous, and officially communicated through channels such as a press release

from the White House, the U.S. Department of State, the U.S. Department of Defense, or an official statement on the floor of the U.S. Congress. Reputable reports from at least two reputable international news organizations would also be sufficient for positive resolution of this question.
- The announcement must occur before January 1st, 2030. Discussions, debates, or proposals about withdrawal do not suffice; there must be a definitive and formal declaration of intent to withdraw.
- In the event of ambiguity or conflicting reports regarding the U.S.'s intention to withdraw from any of these agreements, the question will be resolved by a panel of experts.

Historical Base Rate Data

- The ROK-US Treaty was established in 1953. Neither South Korea nor the United States have ever announced an intention to withdraw from the treaty.

Other Helpful Information

- Center for American Progress: Bridging the Divide in the U.S.-South Korea Alliance
    - "Over the past four years, U.S. President Donald Trump's disdain for the U.S.-South Korea alliance has undermined the partnership, causing a wide gap in trust between the two sides. During his time in office, Trump has made clear that he does not understand the value of U.S. alliances. He has suggested that allies such as South Korea and Japan protect themselves by developing their own nuclear weapons."

A4. Appendix 4: Full descriptions of policies

General policies

All nuclear-armed states sign and ratify the Comprehensive Test Ban Treaty

Background:

- The Comprehensive Nuclear-Test-Ban Treaty (CTBT) bans all nuclear explosions. It was adopted by the UN in 1996 but has not entered into force because 9 specific countries, including some nuclear-armed states, have not yet ratified it.

Action required:

- This policy would require those nuclear-armed states that are yet to sign the treaty to do so.
- It would also require all nuclear-armed states to have ratified the treaty. This would require the country's legislature to approve ratification and develop the laws required by the treaty, including:
- Legislation Banning Nuclear Testing: Specific legislation that explicitly bans nuclear weapon test explosions or any nuclear explosions, in line with the CTBT's requirements.

- Verification and Monitoring: Laws that establish domestic procedures for the implementation of the International Monitoring System (IMS). This involves setting up and maintaining national data centers to monitor and verify adherence to the treaty, including measures for collecting and analyzing data from the global monitoring network.
- On-Site Inspections: Regulations that enable on-site inspections by the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO) to verify compliance.
- International Cooperation: Provisions allowing for international cooperation, including sharing relevant data and engaging in joint activities with the CTBTO or other signatory countries.
- The state parties' instruments of ratification should be submitted to the UN before January 1st 2030.

Further resources:

- Please see resources here.

All nuclear-armed states conduct a failsafe review

Background:

- In the United States' 2022 Nuclear Posture Review it was announced that the Department of Defense "will commission an independent review of the safety, security, and reliability of U.S. nuclear weapons, NC3, and integrated tactical warning/attack assessment systems."

Action required:

- All national governments of nuclear-armed states would establish a review mechanism based on national defense guidelines to identify risks of inadvertent or accidental nuclear use and develop plans for mitigation of these risks. This would include, but is not limited to, false alarms, technical malfunctions, and human error.
- Each government would conduct an analysis to identify potential pathways to unintentional launches of nuclear weapons or false perceptions of being under attack.
- They would then consider areas of intervention to reduce the likelihood of these outcomes. This should include consideration of technical, procedural, capital, and policy measures. The main focus should be on measures the government can take unilaterally to reduce risk from their systems. But if the reviews identify opportunities for risk mitigation that require multilateral action these should be proposed to other nation's governments.
- Governments would ensure needed support for the review process.
- The focus would be on identifying the highest risk areas to propose actionable steps that reduce these risks and enhance safety protocols.
- The review would be conducted and a report produced by January 1st, 2026.

Further resources:

- Please see resources here.

A secure multilateral crisis communications network is established with all nuclear-armed states participating

Background:

- Hotline arrangements, also known as crisis communication channels, are direct communication links established between nuclear-armed states to facilitate rapid and reliable communication during times of heightened tension or crisis. These hotlines aim to reduce the risk of misunderstanding, miscalculation, or unintended escalation that could lead to nuclear war.
- Although there are crisis communication channels between the major adversarial nuclear dyads, there are concerns that these communications are not robust, with instances of communications being shut off, or countries not responding to requests for communications.

Action required:

- A secure multilateral crisis communication network (such as the proposed CATALINK network) is established.
- Key components of the network are:
    - Secure Communications Infrastructure: A state-of-the-art, encrypted communication network that ensures the confidentiality, integrity, and availability of communications between nuclear states. The network should be resilient against potential failures in other communication systems caused by damage to critical infrastructure.
    - Multilateral Participation: All nuclear states participate in the network, emphasizing the shared interest in reducing nuclear risks and enhancing global security. Non-nuclear states are also a part of the network, which is used for crisis communications beyond nuclear weapons risks.
    - Direct Leader-to-Leader Communication: The network enables a secure, private, and direct communication channels between the leaders of nuclear states to facilitate swift and effective crisis management. There are clear protocols for initiating and conducting leader-to-leader communications during crises.
    - Multilateral Communication Channels: There are dedicated multilateral communication channels within the network to facilitate coordination and information sharing among multiple nuclear states. There are protocols for convening multilateral crisis management sessions and decision-making processes.
- Network Governance and Support: a. A governing body with representatives from participating states oversees the network's operation, maintenance, and further development. This body provides technical support and training to ensure that all participating states can effectively use the network and adhere to its security protocols.
- By January 1st, 2030, the network will be established and all nuclear states will have signed up to the system and be actively participating in it.

Further resources:

- Please see resources here.

A Fissile Material Cut-off Treaty is signed by all of the P5 countries and India and Pakistan

Background:

- Fissile materials (highly enriched uranium and plutonium) are essential for nuclear weapons. A Fissile Material Cut-off Treaty (FMCT) would ban production of these materials for weapons.
- Fissile materials are uranium-235 contained in uranium enriched to more than 20% (highly enriched uranium, HEU) and separated plutonium, unless it contains more than 80% plutonium-238.
- A fissile material limit was first proposed in 1946. Since then there have been attempts to establish an FMCT but these have not yet been successful.

Action required:

- The treaty shall apply to newly produced fissile materials and not to existing stockpiles.
- The fissile materials included in the treaty must include:
    - Separated plutonium (unless it contains more than 80% plutonium-238); AND
    - Highly-enriched uranium (more than 20% U-235) and/or weapons grade uranium (more than 85% U-235)
- The treaty would allow the production of fissile material for civil nuclear purposes.
    - All newly produced fissile materials shall be placed under the oversight of the IAEA safeguard in order to ensure they are only used for civil purposes.
- There are several options to verify treaty compliance.
    - IAEA Safeguards Division
        - For this, the IAEA would require an additional budget
        - This would require the replacement of existing safeguards and the strengthening of current data-collecting methods, while ensuring that classified information is protected.
    - An IAEA standard verification group (SVG) independent from the Safeguards Division, plus an independent fissile material cut-off treaty organization (FMCTO)
        - The SVG would be specifically tailored for an FMCT, and not be limited by IAEA's safeguards practices and safeguards agreements. It would conduct inspections, analyze and evaluate information, and share conclusions with the FMCTO.
    - The Online Enrichment Monitor (OLEM), installed by the IAEA to monitor Iranian enrichment activities, could be used as a verification method for the FMCT.
- After agreeing on a cut-off, the countries would
    - exchange confidential declarations about their stockpiles of weapon-usable fissile material annually
    - discuss and address compliance concerns.
- This treaty can be expanded to include all states.

- This agreement would be signed by the listed countries by January 1st, 2030.

Resources:

- Please see resources here.

The USA removes the President of the United States' sole authority to authorize the use of nuclear weapons

Background:

- Currently, the US President can unilaterally order a nuclear launch. For this question, we are referring to a policy that would remove the President of the United States' sole authority to authorize the use of nuclear weapons. Under this proposed policy change, which has been proposed by the Bulletin of Atomic Scientists (among others), the decision to launch a nuclear strike would require additional authorization from other high-ranking elected officials in a specific order of succession.

Action required:

- Under this proposed policy change, which has been proposed by the Bulletin of Atomic Scientists (among others), the decision to launch a nuclear strike would require additional authorization from other high-ranking elected officials in a specific order of succession.
- In this scenario, for a nuclear launch to proceed, the President would first need to obtain approval from the Vice President and the Speaker of the House. If either of these two officials is unavailable or incapacitated, the decision would then pass down a list of successors as defined by the Federal Emergency Management Agency (FEMA)'s list of people who may make decisions in the event that the President of the United States is incapacitated.
- Under this policy, these officials would have the authority to reject the President's request to launch nuclear weapons under two specific circumstances:
    - If they believe the President's request is not 'valid':
        - As specified by the Bulletin of Atomic Scientists: "A veto would be compatible with the 25th Amendment to the Constitution, which allows for the removal of the president from office if the vice president and a majority of the Cabinet deem him or her physically or mentally "unable to discharge the powers and duties of his office."
    - If they determine that the proposed nuclear strike would violate the Law of Armed Conflict, which governs the legal use of force in times of war:
        - As specified by the Bulletin of the Atomic Scientists: "All US military operations—including the use of nuclear weapons—are governed by the Law of Armed Conflict (LOAC), which requires that any use of force comply with three basic principles: military necessity (attacks must be limited actions necessary to accomplish legitimate military objectives); distinction (attacks must discriminate between military and civilian targets;

and proportionality (the military objective must outweigh the harm caused to civilians)."

- The purpose of this policy would be to provide additional checks and balances on the President's nuclear launch authority, reducing the risk of an irrational, illegal, or otherwise illegitimate nuclear strike. It aims to distribute the decision-making power and ensure that the decision to use nuclear weapons is not made by one individual alone without appropriate oversight and consensus.
- The relevant laws would be changed before January 1st, 2026.

Resources:

- Please see resources here.

P5 states 1) jointly develop a risk assessment framework for the use of AI models in nuclear command, control and communication systems, and 2) agree to a moratorium on the use of high-risk AI models in NC3 systems

Background:

- Progress in artificial intelligence (AI) has accelerated in recent years and AI tools are being integrated into workflows in many fields. However, understanding of AI remains limited. Today's AIs are error-prone and the mechanisms they use to make decisions are largely inscrutable.

Action required:

- P5 states should jointly develop a framework to assess the risks of integrating an AI model into their NC3 systems.
- Following Saltini, this framework should include factors inherent in AI models (such as the degree of transparency, rate of errors in outputs, degree of alignment, and vulnerability to cyber attacks), and factors related to the integration of a model into the NC3 system (such as the importance of the task for which the AI is being used, and the degree of autonomy the AI system with which the AI system operates).
- Using this framework, P5 states should identify the features of an AI system and its proposed use in an NC3 system that ought to be considered 'a high-risk application'.
- P5 states would also initiate discussions on reducing the risk from AI-enabled cyberattacks to NC3 systems.
- The states should then agree to a moratorium on the use of high-risk applications of AI in NC3 systems. This does not entail a moratorium on the use of any AI in NC3 systems. But rather, only limits the uses of AI that (due to technological limitations and/or integration risks) pose a level of risk that the P5 nations collectively agree is unacceptable.
- This policy will be considered implemented if, before January 1st 2027, a joint framework for assessing the risks of AI use in nuclear command, control and communications systems has been developed (or approved) by the P5 nuclear states, and the P5 states have declared a moratorium on some applications of AI systems in NC3 based on risk assessment using the framework.

Resources:

- Please see resources here.

Policies specific to the China and the USA domain

The USA implements a no-first-use policy

Background:

- A "No-First-Use" (NFU) policy refers to a commitment by a nuclear-armed state to only use nuclear weapons in retaliation to a nuclear attack.
- Only two nuclear-armed states (China and India) have a declared NFU policy. Other nuclear-armed states, including the USA, have maintained a policy that does not preclude the first use of nuclear weapons.

Action required:

- To implement the policy, the national government would issue an official policy statement confirming its commitment to NFU. The military and defense departments would adjust their strategies and doctrines to align with NFU, ensuring no resources are devoted to first-use capabilities. The country would consult closely with its allies to assure them of the continued strength of its defensive commitments, emphasizing that NFU would not compromise collective security.
- The country's government would also declare its shift to an NFU policy in documents outlining its nuclear posture. E.g. The 2018 U.S. Nuclear Posture Review (NPR) maintains the policy “the United States would only consider the employment of nuclear weapons in extreme circumstances to defend the vital interests of the United States, its allies, and partners.” The next NPR would make clear that the policy has changed as such that ‘extreme circumstances’ would not result in using nuclear weapons in any context other than retaliation against another country having used nuclear weapons (against either the United States or a United States ally).
- The official policy statement would be made before January 1st, 2026.

Resources:

- Please see resources here.

The USA and China sign a missile launch notification agreement

Background:

- There is a risk that missile launches could be misinterpreted as a nuclear attack. To reduce this risk, the US and Russia have a Ballistic Missile Launch Notification Agreement. This was signed in 1988 and remains in force. China and Russia also have a launch notification agreement, which was signed in 2009 and was renewed in 2020.

- No missile launch notification agreement exists between the US and China, but there have been recent discussions of such an agreement.

Action required:

- The countries develop an agreement on mutual missile launch notifications.
- Drawing on a proposal made by Acton et al. for a trilateral US-China-Russia notification launch agreement, the agreement shall contain:
    - Notifications for types of launches, such as
        - All space launches
        - Test launches of ballistic and boost-glide missiles
        - Test launches of missile defense interceptors
    - Details on which test launches are subject to the agreement, such as
        - Exceeding a distance of 500km between launch and impact point
        - The planned apex altitude exceeds 500km
        - The planned maximum speed exceeds 2km/s
    - Notification properties
        - The timeframe for pre-launch notifications should start at least 24 hours before the start of the launch window
        - Cancellation notifications should be provided
        - Notifications should contain the following information:
            - Type of launch
            - Total number of launch systems
            - The basing mode (earth, sea, air) of each launch system
            - The launch area for each launch (site, facility, ocean quadrant, body of water)
            - The planned payload impact area or launch azimuth
            - Time and date for start and end of the launch window
    - The implementation of communication channels for information exchange
- The policy will be considered to be implemented if the countries reach agreement on any missile launch notification and communicate this via official channels, government representatives or press releases. They need not be exclusive parties to the agreement, multilateral missile launch notifications would also count towards resolution.
- This agreement will be signed by both parties by January 1st, 2026.

Resources:

- Please see resources here.

China and the USA establish regular, high-level nuclear dialogue

Background:

- Insufficient communication and understanding between the US and China on nuclear issues could breed mistrust and miscalculation. In November 2023, President Biden and President Xi met and discussed arms control issues. However, regular dialogues could enhance stability and identify areas for cooperation.

Action required:

- The U.S. and China would negotiate and sign a bilateral agreement establishing a nuclear dialogue mechanism, outlining its purpose, structure, and procedures.
- Before each dialogue, both sides would engage in preparatory work, such as exchanging agendas and position papers, to ensure productive discussions. After each dialogue, both sides would implement agreed-upon actions and report on progress at subsequent meetings.
- The dialogues would be held on a regular basis, such as annually or semi-annually, to ensure consistent engagement and progress on nuclear issues.
- The dialogues would involve senior officials from both countries' defense, foreign affairs, and energy departments, as well as military representatives, to ensure comprehensive discussions and decision-making authority.
- The dialogues would cover a wide range of nuclear issues, including strategic stability, nuclear doctrine, risk reduction measures, nonproliferation, nuclear security, and the impact of emerging technologies on nuclear dynamics.
- The dialogues would provide a platform for both sides to share information on their nuclear policies, capabilities, and concerns, helping to build transparency and confidence.
- The dialogues would identify areas where the U.S. and China could cooperate on nuclear issues, such as preventing nuclear terrorism, securing nuclear materials, or managing nuclear crises in third countries.
- Both states would sign the agreement before January 1st, 2026.

Resources:

- Please see resources here.

Policies specific to the Russia and NATO domain

The USA eliminates its launch-on-warning posture

Background:

- The Launch on Warning (LoW) posture is a military strategy in which a country prepares to launch its nuclear weapons based on warnings of an incoming attack before enemy warheads actually strike the territory. This policy stems from a perceived need for quick response to avoid decimation of a nation's own nuclear forces in a surprise attack.
- Currently, the US and Russia maintain a LoW posture, which allows for the launch of intercontinental and submarine-based ballistic missiles upon detection of incoming missiles, even though no physical damage has yet occurred. This strategy heavily relies on the reliability of warning systems which detect potential nuclear threats.

Action required:

- The elimination of the USA's LoW posture should be officially communicated through the next formal document outlining the country's nuclear posture, i.e., the Nuclear Posture Review (NPR). This process will ensure the policy change is integrated into the broader national security strategy, reflecting an updated assessment of nuclear threats and the role of nuclear weapons in defense policy.
- The revised nuclear posture document will clearly outline the steps necessary to implement the new policy of eliminating the LoW posture. Once the document is published, a targeted communication strategy will be executed to disseminate the policy change across relevant branches of the military and to key stakeholders in government and allied nations. This strategy will include detailed briefings, updates to operational protocols, and adjustments in training programs for military personnel to ensure a seamless transition to the new posture. The communication plan will also extend to informing international bodies and the general public, reinforcing the country's commitment to reducing nuclear risks and enhancing global security.
- The implementation will also introduce de-alerting measures to extend the time required for nuclear weapon launches. This will include physical and procedural changes such as removing warheads from missiles and implementing technical barriers that prevent rapid launch. These steps will ensure the elimination of LoW by ensuring that even if a decision is made to launch, additional time and steps would be required to execute the order.
- The elimination of the country's LoW posture should be officially communicated by January 1st, 2026.

Resources:

- Please see resources here.

Russia eliminates its launch-on-warning posture

Background:

- The Launch on Warning (LoW) posture is a military strategy in which a country prepares to launch its nuclear weapons based on warnings of an incoming attack before enemy warheads actually strike the territory. This policy stems from a perceived need for quick response to avoid decimation of a nation's own nuclear forces in a surprise attack.
- Currently, the US and Russia maintain a LoW posture, which allows for the launch of intercontinental and submarine-based ballistic missiles upon detection of incoming missiles, even though no physical damage has yet occurred. This strategy heavily relies on the reliability of warning systems which detect potential nuclear threats.

Action required:

- The elimination of Russia's LoW posture should be officially communicated through the next formal document outlining the country's nuclear posture. This process will ensure the policy change is integrated into the broader national security strategy, reflecting an

updated assessment of nuclear threats and the role of nuclear weapons in defense policy.

- The revised nuclear posture document will clearly outline the steps necessary to implement the new policy of eliminating the LoW posture. Once the document is published, a targeted communication strategy will be executed to disseminate the policy change across relevant branches of the military and to key stakeholders in government and allied nations. This strategy will include detailed briefings, updates to operational protocols, and adjustments in training programs for military personnel to ensure a seamless transition to the new posture. The communication plan will also extend to informing international bodies and the general public, reinforcing the country's commitment to reducing nuclear risks and enhancing global security.
- The implementation will also introduce de-alerting measures to extend the time required for nuclear weapon launches. This will include physical and procedural changes such as removing warheads from missiles and implementing technical barriers that prevent rapid launch. These steps will ensure the elimination of LoW by ensuring that even if a decision is made to launch, additional time and steps would be required to execute the order.
- The elimination of the country's LoW posture should be officially communicated by January 1st, 2026.

Resources:

- Please see resources here.

Russia and the USA sign an arms control treaty succeeding New START

Background:

- New START was signed on April 8, 2010, by President Barack Obama of the United States and President Dmitry Medvedev of Russia. The treaty entered into force on February 5, 2011, after ratification by both countries.
- New START limits the number of deployed strategic nuclear warheads to 1,550 for each country, which is approximately 30% lower than the previous START treaty. It also limits the number of deployed and non-deployed intercontinental ballistic missile (ICBM) launchers, submarine-launched ballistic missile (SLBM) launchers, and heavy bombers equipped for nuclear armaments to 800 for each country. The treaty includes a verification regime, which allows both countries to monitor each other's compliance through various means, such as on-site inspections, data exchanges, and notifications.
- The treaty's duration was set to 10 years, with an option to extend it for an additional five years if both parties agreed. In February 2021, just days before the treaty was set to expire, the United States and Russia agreed to extend New START for another five years until February 5, 2026.

Action required:

- The US and Russia negotiate an arms control framework succeeding New START, which expires in 2026. This could be realized by adapting the existing New START framework,

or negotiating a new arms control treaty, expanding and building on limits and practices established with New START.

- Similar to New START, this framework should include:
    - Limits on strategic nuclear assets:
        - Deployed ICBMs, SLBMs and heavy bombers
        - Warheads on deployed ICBMs, SLBMs and heavy bombers
        - Deployed and non-deployed ICBMs, SLBMs and heavy bombers
        - These limits should be similar to those specified in New START. They should not exceed an increase of 20% above the figures in New START for comparable weapons. E.g. The limit for the number of deployed strategic nuclear warheads should be no greater than 1860.
    - Verification, monitoring and transparency measures, such as:
        - Mutual onsite inspections on military bases with deployed ICBMs, SLBMs and bombers, and facilities with non-deployed systems.
        - Exchanges of data regarding numbers and locations of deployed strategic assets and telemetric information for ICBM and SLCM launches
        - Pre-launch notifications for ballistic missile launches
        - Notifications regarding new, treaty-accountable systems
        - Unique identifiers for launch systems
        - Non-Interference with national technical means of verification, such as satellite imagery
        - The Bilateral Consultative Commission (BCC), or a similar body overseeing compliance and implementation
    - Additionally, including other nuclear capabilities that are not covered by New START should be considered and addressed if appropriate, such as:
        - New long-range nuclear-capable weapon systems that do not fall under New START definitions
        - Short- and medium-ranged nuclear weapons
        - Nonstrategic nuclear weapons
        - Nondeployed nuclear warheads
        - A potential limit on all nuclear warheads (deployed, nondeployed, strategic, or tactical).
    - The negotiations could also cover other issues related to strategic stability, such as nonnuclear capabilities, for example ballistic missile defenses and long-range conventional capabilities (such as SLCMs and land-based MIRVed missiles), or the deployment of US nuclear weapons in European NATO countries.
- This policy will be considered implemented if the US and Russia agree on and ratify an arms control agreement limiting the number of their strategic weapons by January 1st, 2027, and communicate this via official channels, government representatives, or press releases. This includes an expansion or adaptation of New START, or the negotiation and ratification of a new arms control agreement limiting strategic (and possibly other) weapons.

Russia and the USA agree on limits or bans for intermediate-range missiles

Background:

- The US and Russia previously banned intermediate-range missiles under the Intermediate-Range Nuclear Forces Treaty.
- This treaty was ratified by both states in 1988 and banned all nuclear and conventional ground-launched ballistic missiles, cruise missiles, and missile launchers with ranges of 500–5,500 km. By 1991, the two states had destroyed over 2,600 nuclear weapons. This was followed by 10 years of inspections to ensure compliance, and a further 5 years of regular meetings and information sharing. But in August 2019 the US withdrew from the treaty citing Russian non-compliance.

Action required:

- The US and Russia reassume their obligations under the INF treaty that expired in 2019, or negotiate a new arms control framework that bans ground-based weapon systems with ranges between 500 and 5,500 km.
- In accordance with the expired INF, the US and Russia should agree to ban and dismantle all ground-based missiles with ranges that fall between 500 and 5,500 km.
- In accordance with the expired INF, this agreement should contain:
    - A comprehensive definition and list of missiles subject to the treaty, ideally covering all types of warheads (conventional, nuclear, and others). This definition should cover possible future weapon systems with ranges between 500 and 5,500 km, and include an obligation to report the development and deployment of new weapon systems that could fall under the treaty's definition.
    - A reasonable, but short timeframe within which all missiles of interest shall be eliminated.
    - Verification, monitoring and transparency measures, such as:
        - Data exchanges on the elimination of missiles agreed upon
        - On-site inspections of missile operating bases, and of facilities for missile support, production, and elimination
        - An agreement to not interfere with national technical means of verification (e.g. satellite imagery)
        - The verification regime of New START could be applied with almost no modifications to intermediate-range weapon systems.
- This policy will be considered implemented if the US and Russia agree on an agreement banning weapon systems with ranges of 500-5,500 km by January 1st, 2027, and communicate this via official channels, government representatives, or press releases.
- This includes both the revival of the INF treaty, and the negotiation and ratification of any other treaty limiting or banning ground-launched ballistic and cruise missiles with ranges between 500 and 5,500 km. Any treaty that contains a limit or ban on such capabilities, and is ratified by both states, counts towards resolution.

Resources:

- Please see further here.

The USA decreases the role of nuclear weapons with a yield of less than 50kt in its nuclear posture

Background:

- The US Navy currently fields the W76-2 warhead, which has an explosive yield of less than 10 kilotons. Some critics of these relatively low-yield nuclear weapons argue that they threaten strategic stability or are escalatory because they may lower the actual or perceived threshold for nuclear use.
- Advocates of keeping low-yield weapons in the US arsenal argue that they are important for deterring the use of low-yield nuclear weapons by adversaries such as Russia or China, by increasing the credibility of a US nuclear response (given that US adversaries may think America is unlikely to respond with its standard-yield weapons to the use of a low-yield weapon).

Action Required:

- The US Government would make a unilateral declaration announcing its commitment to reduce the development, production, and deployment of low-yield nuclear weapons by 2030, outlining the rationale and steps involved. In this context, a low-yield nuclear weapon refers to a weapon with an explosive yield of less than 50 kilotons.
- The country would update its official nuclear doctrine to reflect this commitment, stating that low-yield nuclear weapons will play a diminished role in its national security strategy and that it will work towards their reduction.
- The country would reduce the number of deployed low-yield nuclear weapons from operational bases and storage sites, and would reduce the associated delivery systems, such as short-range missiles, artillery shells, and depth charges.
- The declaration will be made by January 1st, 2025, and the proportion that low-yield nuclear weapons make up of the country's stockpile would be (at least) halved by 2030 (relative to 2024 numbers).

Resources:

- Please see resources here.

Russia decreases the role of nuclear weapons with a yield of less than 50kt in its nuclear posture

Background:

- Russia currently fields several low-yield nuclear weapons, such as the Iskander-M short-range ballistic missile (yield of 10-50 kilotons) and the 9M729 cruise missile (yield of about 10 kilotons).
- Some critics argue that these weapons are destabilizing because they lower the threshold for nuclear use and could lead to escalation in a conflict. Advocates of these weapons argue that they are necessary to counter perceived conventional military advantages of NATO and to provide flexible options for regional deterrence.

Action Required:

- Russia would make a unilateral declaration announcing its commitment to reduce the development, production, and deployment of low-yield nuclear weapons by 2030, outlining the rationale and steps involved. In this context, a low-yield nuclear weapon refers to a weapon with an explosive yield of less than 50 kilotons.
- Russia would update its official nuclear doctrine to reflect this commitment, stating that low-yield nuclear weapons will play a diminished role in its national security strategy and that it will work towards their reduction.
- Russia would reduce the number of deployed low-yield nuclear weapons from operational bases and storage sites, and would scale back the associated delivery systems, such as short-range ballistic missiles, cruise missiles, and tactical aviation.
- Russia would also limit the development and production of new low-yield nuclear warheads and delivery systems, focusing its modernization efforts on strategic systems and conventional capabilities.
- The declaration will be made by January 1st, 2025, and the proportion that low-yield nuclear weapons make up of the country's stockpile would be (at least) halved by 2030 (relative to 2024 numbers).

Resources:

- Please see resources here.

The USA increases the role of nuclear weapons with a yield of less than 50kt in its nuclear posture

Background:

- The United States currently maintains a mix of high-yield and low-yield nuclear weapons in its arsenal. High-yield weapons, with explosive power measured in hundreds of kilotons or megatons, are designed primarily for strategic deterrence against major nuclear powers. Low-yield weapons, typically defined as those with yields below 50 kilotons, are intended for more limited, tactical scenarios.
- In recent years, there has been growing debate within U.S. defense and policy circles about the role of low-yield weapons in U.S. nuclear strategy. Proponents argue that these weapons can reduce the harm caused by counterforce attacks, provide a more credible deterrent against limited nuclear attacks and can help counter perceived advantages in other states' arsenals, particularly Russia's. Critics warn that an increased emphasis on low-yield weapons could lower the threshold for nuclear use and increase the risk of escalation.
- The 2018 Nuclear Posture Review (NPR) called for the development of new low-yield options, leading to the deployment of the W76-2 low-yield submarine-launched ballistic missile (SLBM) warhead in 2019.

Action required:

- The United States further increases the emphasis on low-yield nuclear weapons in its nuclear posture, relative to high-yield weapons. This would involve the following:

- Force structure changes: The United States would gradually adjust the composition of its nuclear arsenal to include a larger proportion of low-yield weapons, such as the W76-2 SLBM warhead and potential new low-yield warhead designs for other delivery systems (e.g., air-launched cruise missiles, land-based missiles). This would be accompanied by a corresponding reduction in the number of high-yield weapons, while still maintaining a robust strategic deterrent.
- Declaratory policy: The United States would update its declaratory nuclear policy to more explicitly highlight the role of low-yield weapons in deterring and responding to limited nuclear attacks. This could involve statements emphasizing the U.S. commitment to a flexible and proportionate nuclear response, tailored to the specific nature of the threat.
- Operational planning: U.S. military planners would develop new concepts of operation and war plans that more fully integrate low-yield nuclear options into the overall U.S. nuclear posture. This would include refining targeting plans, command and control procedures, and training and exercises to ensure the effective and responsible use of low-yield weapons in a range of scenarios.
- This policy will be considered implemented if, by January 1st 2025, the US Department of Defense formally articulates the increased emphasis on low-yield weapons in a Nuclear Posture Review, and the proportion that low-yield nuclear weapons make up of the country's stockpile is (at least) doubled by 2030 (relative to 2024 levels).

Resources:

- Please see resources here.

Russia increases the role of nuclear weapons with a yield of less than 50kt in its nuclear posture

Background:

- Russia maintains a diverse nuclear arsenal that includes both strategic and tactical weapons, with varying yields. In recent years, Russia has placed a growing emphasis on the role of low-yield, tactical nuclear weapons in its military doctrine and force structure.
- Russian military strategists view tactical nuclear weapons (including weapons with a yield below 50kt) as a means of offsetting perceived conventional military disadvantages vis-à-vis NATO and as a tool for escalation control in regional conflicts. Russia's "escalate to de-escalate" doctrine envisions the limited use of low-yield nuclear weapons to compel an adversary to back down in a crisis or conflict.
- Russia has been modernizing its tactical nuclear arsenal, including the development of new delivery systems such as the Iskander short-range ballistic missile and the Kalibr cruise missile, which can be equipped with low-yield nuclear warheads.

Action required:

- Russia decides to further increase the emphasis on low-yield nuclear weapons in its nuclear posture, as part of its ongoing efforts to strengthen its regional deterrence and warfighting capabilities.
- This shift in emphasis would involve the following steps:

- Force structure changes: Russia would accelerate the modernization and expansion of its tactical nuclear forces, with a particular focus on low-yield warheads and delivery systems. This could include the deployment of additional Iskander and Kalibr missiles, as well as the development of new low-yield warheads for other tactical systems such as artillery, torpedoes, and depth charges.
- Doctrinal refinement: Russia would update its military doctrine to more clearly articulate the roles and scenarios for the use of low-yield nuclear weapons. This could involve a more explicit endorsement of the "escalate to de-escalate" concept and a lowering of the stated threshold for the use of tactical nuclear weapons in response to conventional threats.
- Training and exercises: The Russian military would intensify its training and exercise program for the use of low-yield nuclear weapons, including more frequent and realistic drills simulating their employment in a range of operational scenarios. This would be aimed at enhancing the readiness and proficiency of Russian forces in the tactical nuclear domain.
- This policy will be considered implemented if, by January 1st 2025, the Russian Government formally articulates the increased emphasis on low-yield weapons, and the proportion that low-yield nuclear weapons make up of the country's stockpile is (at least) doubled by 2030 (relative to 2024 levels).

Resources:
- Please see resources here.

Policies specific to the Korean Peninsula domain

The USA and North Korea establish Track 1.5 diplomacy to facilitate regular dialogue and cooperation

Background:
Track 1.5 diplomacy is a form of informal dialogue between officials and non-officials, often involving academics, experts, and former government officials and military officials. It complements official Track 1 diplomacy by providing a less formal platform for exchanging ideas and building relationships.

Action required:
- The United States and North Korea agree to establish a Track 1.5 diplomacy mechanism to facilitate regular dialogue and cooperation on issues of mutual concern.
- The Track 1.5 mechanism would involve the following elements:
    - Participants: The dialogues would involve a mix of current and former government officials, military officials, academics, experts, and think tank representatives from both countries. Participants would be selected based on their expertise and ability to contribute to constructive discussions.

    - Format: The Track 1.5 dialogues would take place regularly, such as on a quarterly or semi-annual basis, alternating between locations in the United States and North Korea or in a neutral third country. The meetings would be held in a private, informal setting to encourage open and frank exchanges.
    - Agenda: The dialogues would cover a wide range of issues, including denuclearization, sanctions relief, economic cooperation, humanitarian concerns, and people-to-people exchanges. The specific agenda would be agreed upon by both sides in advance of each meeting.
    - Reporting: While the discussions themselves would be confidential, the organizers would prepare a summary report after each dialogue, highlighting the key points discussed and any areas of agreement or disagreement. These reports would be shared with the respective governments to inform official policy-making.
    - Coordination with official diplomacy: The Track 1.5 dialogues would be designed to complement, not replace, official diplomatic channels. The organizers would work closely with their respective governments to ensure that the Track 1.5 process aligns with and supports official efforts to improve bilateral relations.
- The United States and North Korea would officially endorse the Track 1.5 mechanism and commit to supporting its operation, including by:
    - Appointing a senior official from each government to serve as a liaison to the Track 1.5 process and facilitate communication between the Track 1.5 participants and official policymakers.
    - Providing the necessary resources, including funding and logistical support, to ensure the regular and effective functioning of the Track 1.5 dialogues.
    - Considering the insights and recommendations generated by the Track 1.5 process in official policy deliberations and decision-making.
- The Track 1.5 mechanism should be established and hold its first meeting by January 1, 2026, with subsequent meetings occurring regularly thereafter.

Resources:

- Please see further here.

The USA declares that it will not conduct left of launch attacks on North Korean nuclear command, control and communications systems.

Background:

- Media reports of statements from US government officials have suggested that the USA is actively pursuing ‘left of launch’ attack capabilities, i.e. capabilities (e.g. cyber attacks) that prevent an adversary launching a nuclear strike.
- Some have argued that the US pursuing these capabilities increases risk, as by creating doubt about the security of NC3 systems, it could make the North Korean leader quicker to use nuclear weapons in a crisis. However, there are concerns about whether such a declaration would be believed.

Action required:

- The US Government declares that it will not conduct ‘left of launch’ attacks on North Korean NC3 systems. That is, it declares that it will not engage in cyberwarfare that interferes with North Korean NC3 systems, with the goal of disabling launch abilities.
- This declaration would be made by a US Government official, speaking in an official capacity, and reinforced in US Nuclear Posture Review documents.
- The declaration would be a statement only and would not require the US to take any measures to prove it is complying with the declaration.
- An official declaration should be made by January 1st, 2025.

Resources:

- Please see resources here.

The United States establishes a liaison office in Pyongyang, North Korea, to facilitate communication, diplomacy, and engagement with the North Korean government

Background:

- It’s been reported that the US and North Korea have tried to establish liaison offices in the past. This includes a 1994 agreement—which included liaison offices amongst other measures—that was signed but later reneged on.

Action Required:

- The U.S. and North Korea negotiate and sign a bilateral agreement allowing for the establishment of a U.S. liaison office in Pyongyang, outlining its purpose, structure, and operating procedures.
- The U.S. selects and trains a team of diplomats and support staff to work at the liaison office, with expertise in Korean language, culture, and politics.
- The liaison office would serve as a direct channel of communication between the U.S. and North Korean governments, facilitating regular dialogue and exchanges on a wide range of issues, including denuclearization, sanctions relief, human rights, and bilateral relations.
- The presence of a U.S. liaison office in Pyongyang would demonstrate a commitment to diplomacy and engagement with North Korea, helping to build trust and reduce tensions on the Korean Peninsula.
- The liaison office would be operational by January 1st, 2030.

Resources:

- Please see resources here.

Policies specific to the India and Pakistan domain

India and Pakistan formalize their low-alert status and agree to maintain their ground-based nuclear weapons in a de-mated state

Background:

- The primary objective of formalizing the low-alert status of nuclear weapons between India and Pakistan is to enhance strategic stability and reduce the risk of accidental or unauthorized nuclear use.
- This policy aims to institutionalize the current practices, ensuring that both nations commit to keeping their ground-based nuclear arsenals in a de-mated and non-deployed state, thereby decreasing the likelihood of rapid escalation to nuclear conflict.

Action required:

- To formalize the low-alert status of their ground-based nuclear weapons, India and Pakistan would enter into a bilateral agreement explicitly outlining the terms and verification mechanisms for maintaining these nuclear arsenals in a de-mated state. This agreement would be negotiated through a series of high-level diplomatic meetings and involve military-to-military dialogues to address technical and operational aspects.
- The agreement would define what constitutes a low-alert status, this must include the separation of warheads from delivery systems, and establish verification measures such as periodic inspections and data exchanges. A joint working group comprising defense and technical experts from both countries would oversee the implementation, ensuring compliance and addressing any issues. Additionally, a communication strategy would be developed to inform domestic and international audiences about the agreement, reinforcing the commitment to nuclear risk reduction and regional stability.
- This agreement would be signed and ratified by both countries by January 1st, 2027.

Resources:

- Please see resources here.

India and Pakistan establish a mechanism to conduct regular exchanges of information on nuclear and military matters

Background:

- India and Pakistan have several existing agreements on information exchanges related to their nuclear and military activities:
- The Agreement on the Prohibition of Attack Against Nuclear Installations and Facilities (1988): Under this agreement, both countries annually exchange lists of their nuclear installations and facilities on January 1st, with the understanding that these sites should not be attacked in the event of a conflict.
- The Agreement on Pre-Notification of Flight Testing of Ballistic Missiles (2005): This agreement requires both countries to provide advance notification of flight tests of ballistic missiles. The notifications must be provided at least three days before the test and include information on the planned launch window, launch area, and impact area.

Action required:

- Building upon existing regular exchanges of information on nuclear facilities, India and Pakistan expand the range of information exchanged. This expansion must include information on:
- Military Budgets: Both countries share their annual defense budgets
- Force Levels: Both sides share data on the number and types of nuclear weapons and delivery systems in their arsenals.
- Doctrine: India and Pakistan exchange information on their nuclear doctrines, including their positions on issues such as no-first-use and minimum credible deterrence.
- The expansion of information exchanges could be implemented in phases, starting with less sensitive data and gradually moving towards more comprehensive disclosures as trust and confidence grow.
- Neutral third parties, such as the United Nations or other international organizations, could facilitate the information exchanges and provide technical assistance in verification and data management.
- An agreement will be signed by January 1st, 2026.

Resources:

- Please see resources here.

An India-Pakistan Nuclear Risk Reduction Center has been established

Background:

- A Nuclear Risk Reduction Center (NRRC) is a bilateral or multilateral mechanism designed to facilitate communication, information exchange, and crisis management between nuclear-armed states. The primary objective of an NRRC is to reduce the risks of nuclear war arising from accidents, misunderstandings, or misperceptions.
- Key functions of an NRRC include direct communication channels, information exchange, crisis management, and implementation of agreements.
- Example of existing NRRCs is the US-Russia Nuclear Risk Reduction Centers, established in 1987.

Action required:

- The Indian and Pakistani governments jointly establish Nuclear Risk Reduction Centers, modeled on the U.S.-Russia Nuclear Risk Reduction Centers.
- The Centers would be in two locations, one in India and one in Pakistan, staffed by respective government officials.
- Clear protocols would be established for when and how the Centers are to be used, including use during emergencies.
- The functions performed by each Center would include:

    - Communication: The centers would provide a secure, reliable, and dedicated channel for direct communication between Indian and Pakistani officials, especially during crises or periods of heightened tensions.
    - Information Sharing: The centers would facilitate the exchange of information on nuclear-related matters, such as planned missile tests, nuclear accidents, or any unusual nuclear-related activities that could be misinterpreted by the other side.
    - Crisis management: In the event of a nuclear crisis or escalating tensions, the centers would enable direct dialogue and clarification of intentions between the parties involved.
    - Treaty Compliance: The center would support the implementation and verification of any existing or future bilateral or multilateral treaties related to nuclear risk reduction between India and Pakistan.
- The centers will be in operation by January 1st, 2030.

Resources:

- Please see resources here.

A5. Appendix 5: Additional details of participants

	Experts		**Superforecasters**		**All participants**	
Country of birth	Count	Proportion	Count	Proportion	Count	Proportion
USA	28	25%	20	49%	48	32%
Pakistan	17	15%	0	0%	17	11%
Germany	9	8%	2	5%	11	7%
India	9	8%	2	5%	11	7%
Hungary	5	5%	1	2%	6	4%
Russia	5	5%	0	0%	5	3%
Italy	3	3%	2	5%	5	3%
UK	3	3%	2	5%	5	3%
South Korea	3	3%	1	2%	4	3%
Canada	1	1%	2	5%	3	2%
Kazakhstan	3	3%	0	0%	3	2%
Ukraine	3	3%	0	0%	3	2%
Czech Republic	2	2%	0	0%	2	1%
France	1	1%	1	2%	2	1%
Mexico	2	2%	0	0%	2	1%

Spain	1	1%	1	2%	2	1%
Argentina	1	1%	0	0%	1	1%
Belgium	0	0%	1	2%	1	1%
Bolivia	0	0%	1	2%	1	1%
China	1	1%	0	0%	1	1%
Denmark	1	1%	0	0%	1	1%
Ireland	0	0%	1	2%	1	1%
Japan	1	1%	0	0%	1	1%
Lebanon	1	1%	0	0%	1	1%
Lithuania	0	0%	1	2%	1	1%
Netherlands	0	0%	1	2%	1	1%
Nigeria	1	1%	0	0%	1	1%
Norway	1	1%	0	0%	1	1%
Poland	0	0%	1	2%	1	1%
Portugal	1	1%	0	0%	1	1%
Saudi Arabia	1	1%	0	0%	1	1%
Serbia	1	1%	0	0%	1	1%
Sri Lanka	1	1%	0	0%	1	1%
Sweden	1	1%	0	0%	1	1%
Turkey	1	1%	0	0%	1	1%
USSR	0	0%	1	2%	1	1%
Zimbabwe	1	1%	0	0%	1	1%
NA	1	1%	0	0%	1	1%

Table A22: *Count and proportion of countries reported as country of birth.*

	Experts		**Superforecasters**		**All participants**	
Country of residence	Count	Proportion	Count	Proportion	Count	Proportion
USA	34	31%	23	56%	57	38%
Pakistan	15	14%	0	0%	15	10%
UK	8	7%	3	7%	11	7%
Germany	8	7%	2	5%	10	7%
India	5	5%	1	2%	6	4%

Austria	5	5%	0	0%	5	3%
Hungary	4	4%	1	2%	5	3%
Sweden	4	4%	0	0%	4	3%
France	2	2%	1	2%	3	2%
Kazakhstan	3	3%	0	0%	3	2%
Mexico	3	3%	0	0%	3	2%
Norway	3	3%	0	0%	3	2%
Canada	0	0%	2	5%	2	1%
Czech Republic	1	1%	1	2%	2	1%
Ireland	1	1%	1	2%	2	1%
Italy	1	1%	1	2%	2	1%
Switzerland	2	2%	0	0%	2	1%
Australia	1	1%	0	0%	1	1%
Dominican Republic	0	0%	1	2%	1	1%
Egypt	1	1%	0	0%	1	1%
Japan	1	1%	0	0%	1	1%
Lebanon	1	1%	0	0%	1	1%
Netherlands	0	0%	1	2%	1	1%
Nigeria	1	1%	0	0%	1	1%
Poland	0	0%	1	2%	1	1%
Portugal	1	1%	0	0%	1	1%
Romania	0	0%	1	2%	1	1%
Serbia	1	1%	0	0%	1	1%
South Africa	1	1%	0	0%	1	1%
South Korea	1	1%	0	0%	1	1%
Spain	0	0%	1	2%	1	1%
Turkey	1	1%	0	0%	1	1%
Ukraine	1	1%	0	0%	1	1%

Table A23: *Count and proportion of countries reported as country of residence.*

Statement ranked first	**Experts**	**Superforecasters**	Chi-squared test	Fisher exact p-value

			p-value	
Strength or fragility of nuclear deterrence				
Deterrence is fragile	33%	24%	0.322	0.427
Deterrence is robust	36%	44%	0.397	0.453
Deterrence could be robust but isn't now	31%	32%	0.925	1.000
Likelihood nuclear escalation following nuclear first strike				
Escalation is very likely	56%	44%	0.172	0.201
Escalation can be prevented	16%	27%	0.147	0.166
Escalation is uncertain	27%	29%	0.808	0.840
Desirability of full disarmament				
Full disarmament now	40%	34%	0.511	0.575
Full disarmament never	19%	20%	0.953	1.000
Full disarmament later	41%	46%	0.548	0.582
Proliferation risk of nuclear energy				
No significant proliferation risk	66%	53%	0.121	0.131
Unacceptable proliferation risk	3%	7%	0.199	0.345
Some proliferation risk	31%	39%	0.346	0.437

Table A24: *Comparison of proportion of experts and superforecasters ranking of 'contentious issues' statements.*

A6. Appendix 6: Views on Nuclear Issues - Statements

For each policy issue, we asked participants to rank the three statements in order of how closely they represent their views.

Full statements for each issue:

- Nuclear deterrence
    - Nuclear deterrence is inherently fragile (easily shattered by human irrationality and chance events—so not a reliable safeguard against nuclear war).
    - Nuclear deterrence can be robust with clear communications, tight command and control, and mutual assured destruction.
    - Nuclear deterrence could be effective, but the current state of global communication, command and control systems, and weapon deployment are easily fallible, and so deterrence is not a safe system at present.

- Nuclear escalation
    - Any deliberate use of a nuclear weapon is highly likely to lead to escalation, resulting in multiple nuclear weapons exchanged.
    - Escalation can be prevented and it is far from certain that the use of one nuclear weapon would be met with a retaliatory nuclear strike.
    - It's very unclear whether the deliberate use of a nuclear weapon would lead to nuclear retaliation or escalation.

- Total disarmament
    - The only way to prevent nuclear catastrophe is to achieve total nuclear disarmament, and we should be pushing for this now.
    - Even if full disarmament could be achieved, it would be undesirable, as it would lead to global instability and increased risk of conventional war.
    - Disarmament might one day be achievable and sustainable, but it would be a mistake to advocate for it now.

- Proliferation risk from nuclear energy
    - With appropriate safeguards in place, nuclear energy can be safely pursued, so we should not deter non-nuclear states that are a party to the nuclear non-proliferation treaty from developing their nuclear energy capacities, including the ability to enrich uranium.
    - Expanding nuclear energy capacity brings an unacceptable proliferation risk, and this should prevent support of new nuclear energy projects in states that currently do not have nuclear weapons.
    - Expanding nuclear energy capacity brings some proliferation risk, and in some instances this should limit the support provided to nuclear energy projects in states that currently do not have nuclear weapons.

A7. Appendix 7: Arguments for forecasts of the probability of nuclear catastrophe by 2045

We asked participants to provide a text rationale for their forecasts. Below we summarize responses made for different ranges of estimates for the probability of nuclear catastrophe by 2045. We provide relevant quotations from participants. These are provided verbatim and have not been edited, so contain some typographical and grammatical errors.

Arguments provided for forecasts <1%

- NC3 safeguards mitigate the risk of accidental nuclear use, while mutually assured destruction discourages intentional warfare between major powers.[54] Nuclear-armed

[54] "Although the nuclear weapons-related incident cannot be ruled out, however; 1. Nuclear weapons are mainly used as a deterrent rather than first-choice weapons due to the Mutually Assured Destruction (MAD). States therefore tend to improve their conventional weapons capabilities to avoid nuclear weapons as the first weapon of choice. 2. The command and control mechanisms to prevent accidental wars are more effective and robust. 3. States are more aware of nuclear war's devastating consequences

states are mostly governed by rational actors who wish to avoid these catastrophic consequences.[55]

- Despite close calls, nuclear weapons have not been used in conflict since 1945, justifying a low base rate forecast.[56]
- To cause 10 million deaths, a nuclear attack would have to involve multiple high-yield weapons or an extended exchange in a major city, which are both unlikely.[57] Several respondents believe an exchange of low-yield nuclear weapons is more likely.[58]
- While some respondents see tensions in the Middle East, Ukraine, and South Asia as potential flashpoints, they don't believe these conflicts will escalate to nuclear use by 2045.[59]

Arguments provided for forecasts ≥ 1% and < 10%

(including human, environmental, and economic impact) and mostly abide by treaties and regimes to prevent such incidents. 4. The ability of a non-state actor to access and effectively use the nuclear weapon is limited."

[55] "I put in 0.1 earlier however, after reading the probability cases above I have changed my answer to 0.46. My rationale for this low probability is the continued success of Nuclear deterrence at work. Even during the worst era of relations between nuclear armed dyads, there has always prevailed some level of rationality. Even a state like North Korea with decidedly trigger happy top leadership has not crossed that threshold. The consequences of using nuclear weapons far outweigh the benefits, as of now. however, the 0.46% has been shown to be akin to getting three 6's consecutively which is not outside the realm of possibility. likewise, a rogue top leader may exercise his/her right to push the nuclear button during a crisis situation. however, in my reckoning there will remain some sane voices in the leadership hierarchy who would advise caution."

[56] "Forecast is less than 1% because in almost 79 years it has not happened once (after Hiroshima and Nagasaki). Depending on the count, there are some 20-odd "close calls" - since the 1950s; a 1 in 20 (and counting) scenario, means <5%. While I guardedly do not agree, I am intrigued with the Tertrais article, "'On the Brink' -- Really?" article from 2017. Trying to track that down to read."

[57] "My view is that while there are many possible pathways to nuclear use (both intentional and inadvertent), the magnitude of casualties mentioned in the scope of this survey could most likely result only from large-scale countervalue targeting against population centres and/or the exchange of hundreds of nuclear weapons in a direct war and/or several large-scale nuclear use incidents over the next two decades out to 2045. At present, I consider these pathways towards the magnitude of casualties mentioned in the scope of this survey to be very remote."

[58] "The presence of tactical and low-yield nuclear weapons makes the possibility of its use more high. States like India- Pakistan, and China have geographical proximity, and there is much probability of the use of low-yield, short-range nuclear weapons. Pakistan has a policy of First Use of nuclear weapons, so in my opinion, the possibility of limited use of nuclear weapons is high between China - Pakistan and India."

[59] "A nuclear strike on another nuclear weapon power will definitely result in a retaliatory strike leading to incalculable destruction of both the countries.I therefore feel that no nuclear power will use a nuclear weapon against another nuclear weapon nation. Again, it is extremely unlikely that a nuclear power will use this weapon against a non nuclear country. Examples are the US not using a nuclear weapon against Korea or Vietnam or Afghanistan but accepted a military defeat. It is the enormity of "The Decision " that prevents any leader from resorting to its use North Korea could be unpredictable against South Korea as the doubt remains weather the US would retaliate against North Korea in such a situation thereby risking a retaliatory strike on its own soil. But can North Korea take this risk which could result in total annihilation Thereby I feel that it's probability of use is extremely extremely low."

- There has not been a nuclear catastrophe since 1945, suggesting a low base rate forecast.[60] That said, the world has come close to nuclear conflict several times, indicating that the risk, while low, is not negligible.[61]
- The threats of sanctions and retaliation disincentivize countries from intentionally using nuclear weapons, but human error and accidental launches are still possible.[62]
- Ongoing rivalries among nuclear powers like Russia, China, the U.S., India, Pakistan, and North Korea increase risk.[63] Proliferation could also increase risk over time.[64]
- Although the possibility is slim, non-state actors could acquire nuclear weapons. Terrorists and mentally unstable leaders could make poor decisions regarding nuclear weapons, leading to catastrophe.[65]

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[60] "Likelihood will be very small but non-negligible. 2045 is basically 20 years way. Viewing the past 20 years, I do not think we came close to a level of nuclear destruction of 10 million getting killed. The 20 years prior also. 20 years from now I also expect to still be alive, and it is difficult to imagine what would cause a nuclear catastrophe of that magnitude. I believe the likelihood of nuclear use to be much higher, even involving substantial number of deaths. But 10 million would be an all-out war as I can't imagine two or more separate incidents adding up to that number in 20 years. I thought 6% was low but enough to say that we should be concerned and try to prevent it, but reconsidering, I lowered that number to 3.5% because I feel that it won't happen in 20 years."

[61] "In the past, we have seen about 1 close call every three years, looking mostly at Russia and the US. Presumably, known are ~half of all calls, increasing the rate to 2 every three years. All other weapon states have nearly 1/3 of the arsenal (with China & others increasing), so they might also have close calls at 1 every three years. Together, this is a close call every year. I assume that only one will lead to an incident as described above, in a heated, arms racing world. 1 in ~20 years is 5%. This does not account for any intentional uses - which are impossible to predict."

[62] "The deliberate use of nuclear weapons is unlikely: the risk of global isolation and of sanctions act as a strong deterrent. (e.g. Russia could detonate a nuclear weapon against Ukraine, but it would risk losing its last remaining trading partners, such as China). The most likely scenario involves (relatively) limited casualties: tactical nukes could be used to target military sites, critical infrastructure, or even unpopulated areas (maybe with a purely demonstrative intent) and therefore most likely cause fewer than 1 million deaths.Massive nuclear catastrophe is therefore improbable: it would require large-scale coordinated attacks by a single country or an exchange of multiple retaliatory strikes by different actors. This is the main reason my forecast dropped significatively from the initial estimate to the current one. The risk of accidental launch exists: outdated systems (the US just stopped using floppy disks, what about other countries?) and human error are possibilities, but a massive, precise launch is very unlikely. The actual nuclear arsenals' operabilities and effectiveness are questionable: deterioration could lead to inoperability, malfunctions, and even risk of self-harm (see the latest Trident II failed test). The residual risk is due to potentially irrational actors (dictators) and the ever-present possibility of escalating military conflict which has been a constant throughout history. Despite a relatively peaceful 75-year period on the global stage, there's now a war on the doorstep of Europe and a state of heightened tension in the world."

[63] "I believe that the probability that by 2045, one or more incidents involving nuclear weapons will cause the death of more than 10 million humans within a 5-year time period is a non-zero chance. With the nuclear arsenals of multiple countries, including the United States, Russian Federation, China, France, United Kingdom, India, Pakistan, North Korea, and Israel over the last several decades, the probability of a nuclear catastrophe is a potential reality in our lifetimes. I have noted that there is a 1% probability of such an event due to various factors: rising regional tensions especially with the Russian-Ukrainian war and Israel-Hamas war, lack of cooperation over arms control efforts, increasing use of emerging technologies which may lead to inadvertent escalation, and prominence of democratic backsliding/rise of authoritarian leaders (e.g. United States and China respectively)."

[64] "While I believe it is unlikely such an event will occur, the current shifting geopolitical climate and potential for proliferation of nuclear weapons in the coming years is driving my rationale for my estimate."

[65] "Overall, after reviewing the material provided as well as other sources, I have come up with my forecast based on the following: 1. Assumed yearly base rate of 5 bps (0.005%). This encompasses

Arguments provided for forecasts ≥ 10% and < 50%

- Rivalries between nuclear powers—particularly Russia and NATO, the US and China, and India and Pakistan—significantly raise the risk of nuclear confrontation.[66] Conventional conflicts could eventually lead to accidental deployment or tactical weapons use, initiating catastrophic warfare.[67]
- Global treaties are unraveling. Without this deterrent, Russia, China, and North Korea are increasing the size of their nuclear arsenals.[68]
- Countries like North Korea, Russia, and China are using more nuclear threat rhetoric, indicating a shift in norms around nuclear weapons.[69]

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accidents and "normal" tensions that could lead to nuclear weapon use. 2. Political leaders can bring about destruction through depression, cognitive breaks, or suicidal thoughts. Ariel Conn's comment about Richard Nixon's depression and drinking in the last days of his presidency influenced me here. Of the nuclear powers, over the next 20 years we could have as many as 38 new leaders. If we assume that any of them could be depressed (4% chance) and also have a cognitive break/suicidal thoughts (1% chance) that could lead to launching of a nuclear weapon, this increased the total number by 152 bps (1.52%). 3. Terrorism is another potential area for the detonation of a nuclear weapon. Three big factors to consider: does the organization have the financing (it would be very expensive to get the materials for a bomb or a completed bomb)? does the organization have the expertise/competency to execute such a plan? and lastly, does the organization have the "will" to act if they satisfy the first two criteria. There are probably about six terrorist organizations that have the global reach that would think about using such a weapon. Probably a 2% chance in any year that they could gather the financing, about a 1% chance they would have the expertise, but I would consider that if they had both their will to act would be at or near 100%. Combining these together gives a yearly base rate for a terrorist attack of 2 bps. So, (overall base rate 5 bps + terrorist base rate 2 bps) times 20 years = 1.52%. Add the additional 1.52% for the political leader mental health arrives at the 3.04%. As you can see, the mental health of leaders for countries with nuclear weapons is by far the biggest risk."

[66] "A China-US conflict because of Taiwan may happen before 2045. That is the year until China may perceive that it has a chance (because of its aging demography and US fleet modernization). Also until 2045, a NATO-Russia conflict may happen which might end up in a nuclear catastrophy."

[67] "The direction of travel is bad. We have a set of countries that are revanchist, nationalist, and otherwise revisionist powers, each of which may benefit from some low level conflict that could slip into a nuclear exchange. Russia, with waning power, is a likely candidate, China may seek violent reunification with Taiwan, North Korea may unleash an attack, and India-Pakistan is alwys one miscalculation away from war."

[68] "The world has seen the unraveling of the treaty regime between the United States and Russia that produced, in the past, some stability in the relationship and capped the size of nuclear arsenals of these two countries. Russia is thought to be increasing its nuclear arsenal, in advance of the expiration of the New Start, and the United States may as well. China is building more nuclear weapons, although I believe they will continue to adhere to a no first use policy. However, as tensions rise between the United States/NATO and Russia, the chances of miscommunication and misperception between these two parties may lead to our stumbling into a nuclear launch. Such a launch from the United States, for example, might lead to 10 million deaths in Russia. It's estimated that a launch of Russian forces of up to 300 missiles to take out U.S. ICBMs would result in 2 million deaths in the United States. In addition, new states may acquire nuclear weapons including Japan, South Korea, and perhaps even Germany as international tensions rise with provocations from North Korea and from the war in Ukraine. These tensions may be exacerbated by U.S. domestic politics which support a more isolationist approach and growing reluctance to offer nuclear deterrence protection to its allies."

[69] "Considering the fact that Russia and China openly declare the intentions towards destroying the existing global order and that Russia destroys the nuclear non-proliferation regime through the military cooperation with North Korea (another nuclear power) and Iran (which will possibly get nuclear weapon in coming decades and which openly declares a purpose of elimination of Israel and invest into this

- Misunderstandings, disinformation, and cyberthreats could all result in escalation.[70]

Arguments provided for forecasts ≥ 50%

- Putin's leadership and Russia's large nuclear arsenal create a high risk of nuclear use in Ukraine or Eastern Europe.[71]
- Disinformation and miscommunications increase the likelihood of inadvertent escalation.[72]
- Conflicts are increasing around the globe, and more states possess nuclear weapons now than they did in the 20th century.[73] Tensions between powers like India and Pakistan and the U.S. and China could eventually lead to nuclear conflict.[74]

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purpose), we deal with facts that 3 of 9 existing nuclear powers are interested in destruction of global order at almost any cost and that another nuclear power, Israel, faces a vital threat from a destructive policy of potential nuclear power, Iran. That's why I estimate the probability of nuclear catastrophe as 30% by 2045."

[70] "North Korea's Nuclear Program: North Korea's pursuit of nuclear weapons has been ongoing concerns for the international community. Despite diplomatic efforts and sanctions, North Korea has continued to conduct nuclear tests and missile launches, heightening tensions in the region. Geopolitical Tensions: The Korean Peninsula has been a hotspot of geopolitical tensions for decades, with historical animosities between North Korea, South Korea, and other regional powers such as the United States, China, and Japan. Any escalation in tensions or miscalculation could potentially lead to a conflict with catastrophic consequences. Nuclear Modernization: Beyond North Korea, other nuclear-armed states continue to modernize their arsenals, raising concerns about the potential for accidents, misunderstandings, or deliberate use. The unpredictability of nuclear deterrence strategies and the possibility of technological failures increase the overall risk of nuclear incidents.Cyber Threats: The increasing reliance on digital systems in nuclear infrastructure introduces new vulnerabilities. Cyberattacks targeting nuclear facilities or command-and-control systems could lead to unintended consequences or escalations, amplifying the risk of catastrophic outcomes.Rogue Actors: Apart from state actors, the proliferation of nuclear materials and technology raises concerns about non-state actors acquiring or using nuclear weapons. The potential for terrorist groups or rogue individuals to gain access to nuclear capabilities adds another layer of uncertainty to the nuclear risk landscape."

[71] "With such a crucial human factor as Putin in power of a nuclear state until at least 2036, with Russia possessing 5889 nuclear warheads, it is probable that Putin will order the use of nuclear weapons in Ukraine or elsewhere in Eastern Europe to protect what he sees as Russian national interests. I remain certain that the probability of this is from 50 to 60%. Considering at least two factors, (1) Putin's irrationality when it comes to foreign policy decision-making, and (2) the population density in Europe and Russia, - 10 million humans within a 5-year time period dead, unfortunately, is a fair estimation, especially if Putin's nuclear use is followed by US / NATO's nuclear response on Russian territory."

[72] "The chances of a direct and deliberate nuclear war between two nuclear weapon states are low in the future. Nevertheless, the chances of inadvertent nuclear war, due to uncertainty, between nuclear weapon states are very high. Anarchy is a predominant feature of international system due to which, according to most of the scholars, uncertainty is inevitable. This uncertainty which is sometimes referred as "others mind problem" creates misunderstanding and misinterpretation of each others actions. Advancement in technology, specifically in disruptive technologies and bourgeoning potential of information warfare further exacerbates the chances of uncertainty and inadvertent nuclear war. Hence, in coming years the chances of inadvertent nuclear war due to information war and disruptive technologies are very high."

[73] "Given the fact that increasingly more countries are threatening with nuclear arms and we observe an increasingly larger number of conflicts, including in Europe and Middle East, there is a higher probability of an accident as well as a nuclear arms use."

[74] "While the chance of an intentional nuclear war is lower, there is a 50-60 percent chance of an accidental or inadvertent nuclear exchange, between the two adversarial dyads i.e. US-China and India-Pakistan. The risk of an intentional nuclear war is lower because of deterrence and mutual

- Emerging technologies and evolving warfare strategies introduce new risks.[75] Tactical weapons, in particular, are considered more acceptable and are obscuring boundaries between conventional weapons and nuclear weapons.[76]
- The collapse of various arms control and nonproliferation agreements reduces formal pathways for avoiding nuclear weapon use. Lack of risk reduction measures among adversarial nuclear powers increases the chance of accidental nuclear exchange.[77]

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vulnerability. However, the risk reduction measures that are necessary to stop escalation are either missing or weak between the two dyads, thereby increasing the risk of accidental nuclear exchange. "

[75] "I believe there is a cautiously high probability of nuclear catastrophe by 2045 due to several factors: The global geopolitical architecture is the most stressed and unstable it's been since the Cold War. This instability is further complicated by multipolar power competition. The likelihood of existing geopolitical fault lines, like the Middle East, becoming nuclearized increases with countries like Iran, Saudi Arabia, and Turkey in the region. New emerging technologies could precipitate pressure on states to adopt a "use it or lose it" mentality regarding their nuclear weapons. Newer nuclear states, especially pariah states like North Korea, might not be as responsible actors. Major powers seem unwilling to respect the security concerns of other major powers, as evidenced by actions like those of the US in the South China Sea and NATO expansion. Finally, advancements in production technologies could make the nuclear fuel cycle easier to master, increasing the chances of irresponsible states and non-state actors acquiring nuclear weapons."

[76] "So called tactical nuclear weapons are having a renaissance. Such weapons are described by proponents and war planners as more "usable", and thus more credible as a deterrent than strategic nuclear weapons. This is false. This class of weapons enfeebles strategic nuclear deterrence, as they give leaders the impression that use of these weapons, at worst, would provoke a like or proportionate response. Leaders may therefore underestimate the risks of using these weapons first. Doctrines and arsenals related to "tactical" nuclear weapons are blurring the line between conventional and nuclear weapons. These weapons are often delivered on dual-capable platforms, which increases the risk of miscalculation. Terms such as "low-yield", "limited", "battlefield" and "tactical" are making the potential use of nuclear weapons more acceptable."

[77] "I approached this from a non-linear angle, looking at the application of chaos theory in the social sciences. I also (very loosely) pulled from other physics concepts, such as black holes and their event horizons. First, I think there are multiple pathways that lead to a possible "incident involving nuclear weapons" by 2045. Government decision-making and public remarks by some nuclear-armed states also seem to be accelerating towards that outcome (or "event horizon"). Furthermore, and arguably more importantly, it seems that the number of pathways explicitly avoiding nuclear exchange are decreasing. I think this is important because language justifying the use of nuclear weapons could be paraphrased as "we had no other choice," so one forecast should be built through a process of elimination of the pathways avoiding use of nuclear weapons. From this vantage point, I assigned the collapse of the various nuclear and conventional arms control, nonproliferation and disarmament agreements a "50%" because noncompliance and state-party withdrawals (by nuclear-armed states in particular) signal a departure from the most formal and concrete pathways avoiding the use of a nuclear weapon. Second, because the potential for the use of a nuclear weapon is never zero when stockpiles exist, I assigned this factor "10%." I think this number is highly variable based on conflicts and new nuclear weapons states. Third, pathways avoiding nuclear war via strategic stability dialogues and high-level (Cabinet and Presidential) engagements between nuclear-armed states seem to still be intact, if only partially. Additionally, this pathway seemed to be the most valuable during events such as the Cuban Missile Crisis, which demonstrates that conflict/tensions can escalate pretty far while still avoiding nuclear use so long as there is high-level dialogue with the world leader intent on using nuclear weapons. Unlike the Cuban Missile Crisis, that high-level dialogue could happen in a variety of combinations amongst the nuclear weapons states (NWS). Considering high-level dialogue between three of the NWS and Russia is diminishing, I assigned the lack of strategic stability dialogues a "5%." Finally, the destabilizing effects of social media, misinformation/disinformation, and other outside factors like powerful nonstate actors (ex. – Elon Musk) could create enough ambiguity to eliminate up to 7-10% of the pathways avoiding nuclear war. This is especially the case if the leader intent on using a nuclear weapon makes decisions in a

A8. Appendix 8: Details of data cleaning

Some of the forecasts given by respondents were incoherent. While we aimed to include all participant views, we also did not want the findings distorted by responses that seemed to be made in error. Here we outline the modifications we made to responses provided in the study.

We implemented the following rules for data cleaning:

- Responses that have any of the following features are considered erroneous:
    - 2030 crux forecasting:
        - Probability of catastrophe conditional on event occurring and probability of catastrophe conditional on event **not** occurring are both lower than the unconditional probability of catastrophe
        - Probability of catastrophe conditional on event occurring and probability of catastrophe conditional on event **not** occurring are both higher than the unconditional probability of catastrophe
        - An unintuitive* forecast that is not explained by the rationales
        - A forecast that is explicitly contradicted by its corresponding rationale
    - Policy effect forecasting
        - An unintuitive* forecast that is not explained by the rationales
        - A forecast that is explicitly contradicted by its corresponding rationale
    - Policy probability forecasting
        - The forecast of implementation conditional on funding is lower than the unconditional forecast of implementation and this is not explained by rationales
- *Unintuitive forecasts were:
    - 2030 crux forecasting:
        - A forecast that the following events would lead to a decrease in risk:
            - A deliberate non-test nuclear detonation
            - An inadvertent non-test nuclear detonation
            - North Korea conducts another nuclear weapons test
            - Any current nuclear-armed state other than North Korea conducts another nuclear weapons test
            - A non-state actor acquires nuclear weapons
            - Iran acquires nuclear weapons
            - Any state other than Iran acquires nuclear weapons
            - There are more than 500 militarized deaths between adversarial domain countries
        - A forecast that the following events would increase risk:
            - An arms control agreement between adversarial domain countries
            - Nuclear-armed states having no-first-use policies
    - Policy effect forecasting:

yes-man vacuum. As for the likelihood of an incident involving nuclear weapons killing more than 10 million people in a five-year period, I think it is nearly certain because of likelihood of a nuclear response, continued side effects from the detonation, and suicide."

            - Forecasts that suggest the following policies would increase risk:
                - AI risk reduction
                - Crisis communications network
                - CTBT is ratified
                - Failsafe reviews
                - FMCT is signed
- Please note that unintuitive forecasts were not considered erroneous if the accompanying rationale suggested that the respondent had understood the question and intended their forecast.
- Erroneous responses were reviewed:
    - In some cases modifications were made to the data. This occurred when:
        - The rationale clearly stated a different value than the forecast
        - On reviewing the rationale and the respondent's other forecasts it was clear that a typographical error had occurred. These errors were usually either omission of decimal points, or including too many or too few zeros in very low probability forecasts.
    - Erroneous responses that couldn't be corrected were deleted.
- If a respondent had three or more erroneous responses in each of the following groups of questions, then all their responses from that question group were deleted, as it seemed unlikely that they had properly understood the forecasting instructions.
    - 2030 conditional crux forecasting
    - Policy effect forecasting
    - Policy probability forecasting

This resulted in the following changes:

- 21 participants' 2030 conditional crux forecasting results were deleted
    - 19 experts
    - 2 superforecasters
- 13 participants' policy effect forecasts were deleted
    - 12 experts
    - 1 superforecaster
- 3 participants' policy probability forecasts were deleted
    - 2 experts
    - 1 superforecaster
- 22 participants had at least one individual forecast deleted (but not any group of forecasts deleted)
    - 15 experts
    - 7 superforecasters
- 20 participants' individual forecasts were modified (but no forecasts deleted)
    - 15 experts
    - 5 superforecasters

A9. Appendix 9: Detail on forecasts on non-test nuclear weapons detonations

Accidental non-test detonation

Question

- What is the probability of an accidental non-test detonation of a nuclear weapon occurring before the 1st of January, 2030?
- (See detailed resolution criteria and notes here)

Probability of event occurring

	Experts				Superforecasters			
	N	Median	25th%	75th%	N	Median	25th%	75th%
Accidental non-test detonation	110	1%	0.01%	10%	41	0.05%	0.01%	0.3%

Table A25: *Summary of participant views on probability of an accidental non-test nuclear detonation by 2030.*

Arguments for very low probability (<0.1%):

- The historical record strongly supports a very low probability of accidental nuclear detonation. Since the advent of nuclear weapons, there have been no known accidental detonations.[78]
- Nuclear-armed states have implemented extensive safeguards and redundant safety measures to prevent such occurrences. Technological advancements have resulted in modern nuclear weapons with multiple fail-safe mechanisms.[79] Many states also store their nuclear weapons separate from triggering mechanisms.[80]
- The nations with the most nuclear weapons have accumulated decades of experience in safely managing their arsenals, leading to well-trained personnel and refined protocols.[81]

[78] "The number of accidental detonations since the start of the nuclear age is zero from what I can tell. There have been fires as well as containment vessel explosions, but those did not result in a nuclear detonation."
[79] "...the near-impossibility of accidentally detonating a nuclear device given the properties of a typical nuclear warhead, ie merely dropping a warhead is not enough; specific physical properties within the bomb have to be achieved for the warhead to achieve critical mass. Given the multiple physical and command-control safeguards built into the weapons handling process, it is essentially impossible to accidentally detonate a warhead."; "Nuclear-armed states take rigorous precautions to prevent accidental detonations of their nuclear weapons. These precautions include strict protocols for handling and maintaining nuclear arsenals, as well as robust safety mechanisms designed to prevent unauthorized or accidental launches. Additionally, advancements in technology and stringent safety standards contribute to minimizing the risk of accidental detonations."
[80] "Most nuclear armed states also don't keep their nuclear weapons on hair trigger alert, with the triggering mechanisms kept separate from fissile cores and/or the warheads kept separate from the delivery systems in peacetime."; "States that don't have very sophisticated controls tend to keep weapons de-mated or disassembled."
[81] "The nations with the most nuclear weapons have had them in quantity for over 60 years and have developed policy and procedures for safe handling."

- States have a very strong interest in preventing accidental detonation.[82]

Arguments for low probability (0.1% to <2%):

- While the event is still considered unlikely, proponents of this probability range acknowledge that accidents cannot be entirely ruled out due to the potential for human error or technical malfunction. Historical "broken arrow" incidents, although none resulted in detonation, serve as reminders of inherent risks.[83]
- There's recognition that not all nuclear states may have equally robust safety measures, especially newer nuclear powers. The complexity of nuclear weapons systems leaves some room for unforeseen errors despite best efforts to anticipate and prevent them.[84]
- Geopolitical tensions leading to increased alert levels or movement of weapons during crises could increase risks associated with these weapons.[85]

Arguments for moderate probability (2% to <20%):

- Those estimating a moderate probability often point to proliferation risks, as new nuclear states or aspiring nuclear powers may lack sophisticated safety protocols and have instability of government.[86]
- Some countries possess aging arsenals with potentially less advanced safety features, which could increase the risk of malfunction.[87] Others are in the process of modernizing their arsenals, which could also increase the risk of accidental detonation.[88]

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[82] "States have a huge interest in making sure an accidental detonation does not occur as it could kill the countries leader is in the area, set off alarm bells in other nuclear armed nations."
[83] "The rationale is that while truly accidental detonations have been extremely rare historically, the risk cannot be completely dismissed to zero given: The large nuclear stockpiles that still exist, with thousands of warheads, The complexity of the systems involved in storing, handling, and maintaining these weapons, The possibility of human error, systems failures, or unforeseen events breaching safeguards and allowing an accidental blast"; "We have not seen any accidental explosion in the past, but it can not be excluded.
[84] "These sources -- https://www.osti.gov/servlets/purl/1426902, https://www.acq.osd.mil/ncbdp/nm/NMHB2020rev/chapters/chapter8.html -- convinced me that the risk of a US accidental detonation are (despite a checkered near-miss history) at present negligible. Call it one in a million. But there's a lot more guess work involved when it comes to assessing risk in Pakistan, India, North Korea, and Russia. Russia in particular, given the size of their arsenal, endemic corner-cutting corruption, and shaky finances is a worry."
[85] "given the risk of nuclear weapons uses is increasing (due to the potential involvement of NATOs to the Russia and Ukraine war and the potential conflict of US and China over Taiwan), the nuclear weapons with increasing alert level would be increased, thus a higher risk of an accidental launches than the past."
[86] "Estimate based on the historical record of near-misses, an overall increase in nuclear numbers by 2030, and the lack of safety mechanisms in states pursuing vertical proliferation (NK, China, Pakistan, in particular)"; "The current geopolitical climate, with increased hostility and renewed interest in deterring attacks, may lead to proliferation of nuclear weapons development programs. That increases the risk of an accidental detonation, I think."; "With more countries with some having unstable governments, I think it is very possible that either in a coup attempt or poor monitoring, lack of repair to infrastructure housing could result in an accidental detonation."; "There have been more broken arrow events in the past and nuclear weapons are safer now than at the beginning of the Cold War. However, some "new" nuclear weapon states might be more prone to accidents (India, Pakistan, especially North Korea)."
[87] "Russia may not have the funds for upkeep of safety measures."; "Nuclear weapons technology in the five NPT NWS has aged considerably (especially in US and Russia). Some components of nuclear weapons require regular refurbishing and / or replacement. Nuclear weapons designers (especially those that designed earlier generations of nuclear weapons) are either retired or retiring in US, Russia, UK and France."
[88] "Some states are in the process of modernisation and developing new warheads. This increases the probability of an accidental non-test detonation."

- Despite extensive safeguards, the risk of an accident cannot be completely eliminated.[89] Increased handling of weapons during modernization efforts or strategic repositioning could create more opportunities for accidents.[90]
- The integration of digital systems into nuclear command and control introduces potential cyber vulnerabilities.[91]
- Non-state actors developing or acquiring nuclear weapons in response to Israel's actions would increase the chance of an accidental detonation.[92]

Arguments for high probability (≥20%):

- Participants arguing for a high probability often present a more pessimistic interpretation of historical data, calculating higher probabilities based on past nuclear-related incidents.[93]
- Two responses in this range mentioned a recent incident that involved accidental launch of an Indian missile into Pakistan.[94]
- Significant concerns exist about safety standards in newer nuclear states or potential future nuclear powers.[95] Respondents in this range believe increasing global tensions and potential conflicts involving nuclear-armed states elevate the risk of accidents or misjudgments.[96]

Expected impact on risk of nuclear catastrophe

	Experts				Superforecasters			
	N	Median relative risk	25th%	75th%	N	Median relative risk	25th%	75th%
Accidental non-test detonation	87	1.0	1.0	2.0	37	1.0	1.0	1.1

[89] "The risk of an accident can never be zero, even with the best safety procedures"
[90] "Russia has been recently moving some of its nuclear weapons toward its Ukrainian border and into Belarus. This movement of material represents an additional risk for accidental detonation: on the one hand, the increased handling of such weapons and the increased level of activity around them raises the risk of human errors, on the other such weapons are now closer to active war zones and exposed to possible attacks or sabotage attempts."
[91] "Cyber threats or AI vulnerabilities – increased digitalization in nuclear operations could enhance these vulnerabilities."
[92] "Also, I can see another chance for an accidental detonation in the Middle East as a non-state actor is trying to develop a bomb in response to Israel's actions, and the attempt results in an accidental detonation."
[93] "Given the total of 39 documented nuclear accidents over the past 74 years, with an average of approximately 0.52 accidents per year during this period. However, in the last 25 years, there has been a significant decrease in their occurrence, with only an average of 0.04 accidents per year. So, the probability of at least one accident happening in the next 6 years is approximately 0.217. So, I would estimate a 21.7% probability of an accidental non-test detonation occurring before January 1st, 2030."
[94] "On March 9, 2023, India accidentally launched the BrahMos missile (unarmed) into Pakistani airspace. The government citied human error and technical malfunction that led to this incident. While such incidents are extremely rare, with the constant increase in stockpile of nuclear states and evolving technology, reversible or irreversible glitches may occur, increasing the risk of catastrophes."
[95] "Some countries who try to be nuclear power due to lack of expertise such casualties may occur"
[96] "The Russia-Ukraine war has many uncertainties in this regard. On behalf of Russia, considering the Prigozsin affair in mid-2023, many accidental events, even a detonation, could happen."

Table A26: *Summary of participant views on change in risk of nuclear catastrophe, conditional on an accidental non-test nuclear detonation.*

Arguments for increased probability of nuclear catastrophe if an accidental detonation occurs:

- An accidental nuclear detonation might be misinterpreted as an intentional attack, potentially triggering retaliation and escalation.[97]
- An incident could erode trust in nuclear safety measures and heighten tensions between nuclear powers.[98]
- Additionally, an accidental detonation might make nuclear weapons seem more "usable," potentially lowering the threshold for their intentional use.[99] The global nuclear order could be destabilized, possibly leading to more aggressive postures or proliferation efforts.
- An accidental detonation signals increased probability of other types of nuclear detonations and a more dangerous world.[100]
- Lastly, some forecasters suggest that an accidental detonation could possibly lead to 10 million deaths, even absent retaliation.[101]

Arguments for decreased probability if an accidental detonation occurs:

- The shock of such an event might lead to greater caution in handling nuclear weapons and prompt the implementation of more robust safety and security measures. These

[97] "If it happens, the fact that it (accidental detonation) is so very unlikely raises the risk that someone will assume it was deliberate and possibly presaging an attack, thus raising the risk of a preemptive counterattack."; "it is possible that the accidental detonation is misinterpreted as an attack. It could even be misinterpreted as a first strike on the nuclear infrastructure (since it will hit a nuclear depot directly for sure)."; "An accidental non-test detonation could, under many circumstances, prompt escalation, causing the revision to my forecast for the conditional here. For instance, were a North Korean nuclear warhead to detonate as a result of a handling error in the course of a crisis, that could be interpreted as a nuclear attack within North Korea (in the fog of war), or otherwise lead to escalation by the United States and South Korea."

[98] "A major accidental detonation would signal a catastrophic failure of nuclear safeguards and controls
It would severely degrade trust and confidence in the nuclear safety systems of whichever state was responsible. This could set off a cycle of escalating nuclear risk-taking, worse threat perceptions, and a fundamentally destabilized environment between nuclear rivals. Such a dangerous erosion of norms and trust could more plausibly lead to further nuclear escalation, increasing the probability of a broader nuclear conflict before 2045"; "There will certainly be a reaction of those near the accidental detonation site as they see the nation state as being careless re the care of nuclear weapons, and that in turn may heighten a concern that such an accident could happen again and actually lead to conflict."

[99] "[an accidental nuclear detonation could] …reduce hesitancy by others to use such a weapon on a battlefield and thereby, counterintuitively, increase the odds of a significant nuclear event."; "This could be because the accident would likely be seen as dangerous but perhaps not as destructive as some people might expect (for example, many people died in Ukraine), and any restraining effect of the nuclear taboo might be lower. "

[100] "A world where nuclear weapons go off accidentally is a world in which I worry a lot more about nuclear weapons going off for any reason."; "if the accident is in part caused by pressure to develop and deploy new nuclear weapons because of political-military leadership fears of nuclear-armed enemies, or if the accident is interpreted as and responded to as an enemy attack or sabotage (especially in a crisis), then the risk of nuclear detonations leading to +10M deaths could increase."

[101] "If the nuclear weapon detonation occur it can in itself be a nuclear catastrophe depending on the place where the incident take place. An accidental detonation can in itself be a nuclear catastrophe, and its taking place increases the risk of a nuclear catastrophe."; "it doesn't mean that it couldn't lead to a nuclear catastrophe. This is particularly true in relatively small and densely populated countries like Pakistan, India, North Korea, the UK and france where geographical limitations would prevent people from 'escaping' the impacted areas"

measures would reduce the risk of accident directly, as well as the risk of non-state actors gaining control of nuclear weapons.[102]

- An accidental detonation could also galvanize public opinion and political will towards nuclear disarmament or arms reduction efforts.[103]
- Furthermore, it could serve as a stark reminder of the dangers of nuclear weapons, potentially making leaders more reluctant to consider their use.[104]
- The incident might also catalyze the development of better crisis communication mechanisms between nuclear powers to prevent misunderstandings.[105]

Arguments for little to no change in probability if an accidental detonation occurs:

- Since nuclear weapons are typically stored in remote areas, an accidental detonation would be unlikely to cause a large number of fatalities.[106] The risks of accidental detonation and intentional use are seen as largely separate issues, suggesting that an accident wouldn't necessarily influence the likelihood of intentional nuclear conflict.[107]
- States would recognize an accident as such and not escalate to full-scale nuclear war. Hotlines and other emergency communications systems would enable leaders to communicate and prevent misunderstanding.[108]

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[102] "If an accident happened (that did not kill 10 million people) I would assume that it would act as a wake up call to improve systems to avoid more accidents, and as a warning of the risks a nuclear weapons"; "I think an accidental detonation would actually make it more likely countries become serious about evaluating and securing their current stockpiles, reducing future risk of non-state actors. It might also accelerate the decomissioning of old warheads, especially if the accidental explosion was caused by an older weapon."

[103] "An accident of this sort would be a stark reminder that safeguards need to be reviewed and improved which should lower the possibility of an outright nuclear catastrophe."; "The additional risk of a nuclear catastrophe is counterbalanced by the fact that a self-harm incident would most likely trigger a massive global push toward reducing the stockpile of nuclear weapons to avoid further instances of such incidents." "I think if there is an accidental detonation, then it has a chance of lowering the threat because I think it would be an eye opening experience for the world and cause nuclear powers to become more active in the control of nuclear weapons to ensure there is not another accident. I almost see it as the scared-straight model."

[104] "In case of accidental detonation, the shock among the international community would be high enough and probably will lead to increase of threshold of using nuclear weapons even among the political and military leaders in such countries like Russia. Also, the accidental detonation (if it will take place at all) would be related to the poor organizational and engineering culture which mostly relevant to the authoritarian states. Briefly speaking, the risk of accidental detonation is higher among those states which pose a significant threat of nuclear attack, but the accidental detonation would deter them from further threatening and blackmailing"

[105] "It might also increasing efforts to ensure international communication lines around accidental weapons detonations. If there are large numbers of civilians casualties or negative impacts on surrounding populations, than there may also be pressure on authorities to curb proliferation."

[106] "I think the only thing that changes my forecast if an accidental explosion happens is the odds that that accidental nuclear detonation resulted in the nuclear catastrophe that we are forecasting. Given that the number of deaths hitting 10 million would require explosion and fallout in a highly populated area, and given that nuclear weapons aren't stored in such places, I think it doesn't change my forecast." "Even if an accidental detonation occurs, the likelihood of killing 10 million people remains minuscule; therefore, no impact upon my estimate in either scenario."

[107] "An accidental nuclear detonation, at best, would impact the immediate surroundings of where a nuclear weapon is stored. Functionally, it is more or less irrelevant to the primary catastrophe question."

[108] "The vast majority of cases of accidental detonation would be identified as such and not lead to escalation. Any single accident would unlikely lead to catastrophic fatalities." "If an accidental detonation occurs, it would most likely occur on the host nation or its allies, not on an adversary nation. Hot lines could be used to diffuse the tension after the event."

- There are some factors that suggest a higher risk and some that suggest a lower risk, effectively canceling each other out.[109]
- One forecaster argued that the location of the accidental detonation—whether it is near the territory of a strategic competitor—would affect whether it is likely to increase risk.[110]

Regarding the scenario where no accidental detonation occurs:

- In the absence of an accidental nuclear detonation, forecasters have varying perspectives on its impact on nuclear risk. Many maintain their original probability estimates, suggesting that the absence of an accident wouldn't significantly change their assessment of overall nuclear risk.[111]

Inadvertent non-test nuclear detonation

Question

- What is the probability of an inadvertent non-test detonation of a nuclear weapon occurring before the 1st of January, 2030?
- (See detailed resolution criteria and notes here)

Probability of event occurring

	Experts				Superforecasters			
	N	Median	25th%	75th%	N	Median	25th%	75th%
Inadvertent non-test detonation	110	1.28%	0.1%	10%	41	0.1%	0.01%	0.5%

Table A27: *Summary of participant views on probability of an inadvertent non-test nuclear detonation by 2030.*

Arguments for very low probability (<0.1%):

- Those who forecast a very low probability argue that there have been no inadvertent non-test detonations in the past 70+ years, despite some close calls.[112] They emphasize the multiple safeguards and strict protocols in place to prevent such occurrences.

[109] "If it doesn't happen, which I find very likely, it won't change my forecast a lot. But if it happened, it perhaps will lead to renewed efforts to minimize the number of weapons and improve the safety conditions of the remaining weapons. This might lead to lower risk of terrorist groups obtaining weapons, and less risk of inadvertent use. Unfortunately, the accident itself could lead to inadvertent use, more or less equalizing the lower risk."
[110] "It depends on where the accidental non-test detonation occurred in relation to the owner of the weapon. If near the owning government's territory, less likely to increase risk. But if it is closer to its "strategic competitor," then more likely to increase risk."
[111] "On the other hand, if there is no accidental denotation , then the chances of a nuclear catastrophe would remain the same as before i.e. 60 % given that its absence alone would not alter the percentage very much."
[112] "Base rate is zero, and while there have been a few close calls involving the Russian military during the Cold War, modern systems seem to be pretty good at detecting weapons."

- These forecasters point to the high level of caution exercised by nuclear powers and the significant improvements in early warning systems and communication channels.[113] They also note that even during periods of high tension, such as the Cold War, decision-makers chose to override malfunctioning early warning systems.[114]
- Some argue that the political and public costs of an inadvertent launch are so high that leaders would be extremely reluctant to act on ambiguous information.[115]

Arguments for low probability (0.1% to 1%):

- Those predicting a low probability acknowledge the historical absence of inadvertent detonations but recognize that the risk is not zero.[116] They cite past incidents of false alarms and near-misses as evidence that the possibility exists.[117]
- These forecasters often point to ongoing geopolitical tensions, the potential for miscommunication, and the increasing complexity of nuclear command and control systems as factors that could contribute to an inadvertent launch.[118]
- However, they believe that existing safeguards, human judgment, and the strong deterrent of mutually assured destruction will likely prevent such an occurrence in most scenarios.[119]

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[113] “Warheads are being decommissioned and disassembled. Most of it is not done manually, but there could be a malfunction that leads to an inadvertent nuclear detonation in this case. In the case of "crossed wires" in communications resulting in an inadvertent launch, I think it is unlikely given the high level of communication between nuclear powers.” “Nuclear-readiness protocols have been upgraded since the last recorded episodes of inadvertent nuclear escalation happened decades ago. Furthermore there are no immediate signs of significant political unrest or drastic deterioration in command and control structures in any nuclear enabled country that could serve as a trigger.” “Especially, the advancement of technology that can monitor adversarial nuclear weapons will be achieved speedily and the decision making processes reflected past data regarding false alarm, crises etc will be advanced that can minimize inadvertent non test detonation.”

[114] “As far as I know it has never happened. The number of close calls, even with the tension at the height of the cold war, tells me that people tend to be very careful in this regard, and have used their own human judgement to override a malfunctioning system.”

[115] “We have precedents that show that even in these cases the officials and/or military in charge of initiating a counter-attack decide not to do so because they assume an error on the part of the satellites and computers.”

[116] “This has not occurred over a long time period, including in periods where nuclear forces were kept on high alert.”

[117] “There have been multiple confirmed instances in the past when the U.S. or Russia thought an attack was occurring and came very close to launching retaliatory strikes before identifying the warnings as false alarms.”

[118] “Given the current trajectory of global politics, the higher degree of polarization between so-called faultlines of authoritarian and liberal states, the gradual exit from American hegemony and the shit to a multipolar or multiplex global order, the chances of miscalculation, and wrong threat assessments and perceptions increase dramatically.” “On the one hand there are more and better communication channels between parties, and more and better means of observation (satellites), decreasing the risk. On the other hand, more automated systems and in the near future perhaps the use of some form of AI, increase the risk because of bugs, or cyberattacks with unintended consequences.”

[119] “The risks of inadvertent nuclear use are significant, but again, a number of occasions have illuminated how individuals will act to stop nuclear use in cases of ambiguous information. These incidents suggest that despite the risks, inadvertent use is rarer than deliberate use.”

Arguments for moderate probability (1.1% to 20%):

- Forecasters in this range express more significant concerns about the potential for an inadvertent non-test detonation. They often cite factors such as increasing global tensions, the proliferation of nuclear weapons to less stable states, and the potential for cyber attacks or other technological vulnerabilities to compromise early warning systems.[120]
- Some point to the development of new weapons systems, like hypersonic missiles, that could reduce decision-making time and increase the risk of misinterpretation.[121]
- These forecasters also emphasize the potential for human error, particularly in high-stress situations, and the possibility of escalation due to misunderstandings or false information.[122]

Arguments for high probability (>20%):

- Those predicting a high probability of an inadvertent non-test detonation express serious concerns about the current state of global nuclear security. They often point to deteriorating relationships between nuclear powers, the erosion of arms control agreements, and the increasing complexity of the international security environment.[123]
- These forecasters emphasize the potential for non-state actors to provoke or manipulate nuclear-armed states, the risks associated with emerging technologies like AI in nuclear command and control systems, and the possibility of accidents or miscalculations in regions with ongoing conflicts involving nuclear powers.[124]
- Some pointed to the lack of bilateral crisis communication tools.[125]

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[120] "There are already conflicts in which nuclear armed states are involved. There remains tension between even more nuclear armed states. This means that there is a likelihood for a missignal or some other inadvertent escalation trigger." "
Given the complexity of the security environment, it is plausible that an inadvertent non-test detonation can occur. For instance, miscalculation about the military use of new and emerging technologies like AI and the increased presence of non-state actors, including in the digital domain (cyber-attacks) can lead to miscommunication and false alarms between nuclear armed states."

[121] "Because of hypersonic weapons and cyberweapons, the speed of warfare has increased. In such conditions a miscalculation is more likely to happen."

[122] "This scenario is possible between US-Russia. Due to the complicated relations between countries and possible Cold War and Arms Race threat any false information can cause misunderstanding."

[123] "Postures of many nations are in greater state of readiness, risk enhancing strategies are being consciously adopted, brinkmanship is being resorted to test reactions, crisis communication mechanisms are missing, tendency to assume the worst of the other is high. So, going down the slippery slope inadvertently is of high probability." "The mistrust between thew nuclear rivals is increasing therefore it may escalate the chances of inadvertent war."

[124] "[E]merging technologies such as Artificial Intelligence (AI) are also bringing more uncertainty to the battlefield. Hence, such developments increase the probability of more conflicts." "
The increased presence of non-state actors in conflicts with nuclear weapon states has elevated the chances of a false flag operation. This can easily be misinterpreted by nuclear weapon states and these confusions/miscommunications can quickly translate into the use of nuclear weapons."

[125] "Just like accidental, the risk of an inadvertent nuclear war is higher. e.g. In the case of India and Pakistan, there are no active crisis communication links, despite the hotline agreement being in place. The accidental launch of a missile in March 2022 is a case in point, where Indian authorities did not use

Expected impact on risk of nuclear catastrophe

	Experts				Superforecasters			
	N	Median Relative risk	25th%	75th%	N	Median Relative risk	25th%	75th%
Inadvertent non-test detonation	88	3.0	1.3	18.5	37	3.0	1.5	10.0

Table A28: *Summary of participant views on change in risk of nuclear catastrophe, conditional on an inadvertent non-test nuclear detonation.*

Arguments for increased probability of nuclear catastrophe if an inadvertent detonation occurs:

- Many respondents argue that an inadvertent non-test detonation could trigger immediate retaliation, potentially leading to a full-scale nuclear exchange.[126] Even if the responsible party acknowledges the mistake, the targeted country might not believe or accept this explanation, especially in a tense geopolitical climate.[127]
- Others point out that an inadvertent detonation would likely occur in a crisis situation, making de-escalation particularly challenging.[128]
- Several respondents mention that even if immediate catastrophe is avoided, such an event would weaken the nuclear taboo, potentially making future use more likely.[129]

the hotline to inform Pakistan about the accidental launch. Such an incident is likely to receive a different and more aggressive response from Pakistan in the future with the potential to develop into a crisis." "As aforementioned, the sheer lack of bilateral crisis communication apparatuses will increase the prospect of miscalculations. This might become a bigger problem because of the rapid evisceration of arms control arrangements, not least between Moscow and Wsdhington."

[126] "If existing mechanisms fail and there is an inadvertent detonation happens, it will lead to retaliation." "This could feasibly prompt a nuclear exchange, which would result in a large number of deaths from nuclear use by multiple nations."

[127] "In case of inadvertent launch, there may be no time and political environment for the victim state to verify that it was indeed an inadvertent launch. Moreover, if the victim state is already on higher alert levels, the likelihood of retaliation is going to be much high."

[128] "An inadvertent detonation is most likely to occur in conditions where Country A mistakenly thinks it is under attack and launches its weapons in response to the "attack". Since Country A is likely to believe that this is its only chance to respond to the attack, it may launch the majority of its nuclear arsenal. This will lead to lots of casualties in country B. Moreover, in response to such an attack from Country A, country B will respond with a nuclear retaliatory strike."

[129] "The results / destruction and its response / retaliation would change the attitude towards nuclear weapons and their use. It could weaken the nuclear taboo and may increase the likelihood of nuclear weapons being used in future armed conflicts." "Considering security concerns of many countries that can weaponize fast, I believe this inadvertent escalation would lead to more states weaponizing, which itself would push the risk of catastrophe up significantly. Then again, it could be scarring enough that people swear off weapons more, but I believe nation states would hedge and become more hawkish, even if individual people were horrified by it."

- Some also argue that an inadvertent detonation would undermine confidence in command and control systems, potentially leading to more hair-trigger alert postures and increasing overall nuclear risk.[130]

Arguments for little to no change in probability if an inadvertent detonation occurs:

- A smaller number of respondents argue that an inadvertent non-test detonation would not significantly change the overall risk of nuclear catastrophe. These forecasters often believe that while such an event would be serious, it wouldn't necessarily lead to further escalation or a larger exchange.[131]
- Some suggest that the shock of an actual nuclear detonation might lead to increased caution and better safeguards, potentially offsetting the increased tensions.[132]
- Others argue that the underlying factors driving nuclear risk (such as geopolitical tensions or proliferation concerns) would remain largely unchanged by a single inadvertent event.[133]

Arguments for decreased probability if an inadvertent detonation occurs:

- A few respondents argue that an inadvertent non-test detonation could potentially decrease the long-term risk of nuclear catastrophe. They suggest that such an event would serve as a wake-up call, leading to renewed efforts in arms control, improved safety measures, and possibly even progress towards disarmament.[134]
- Some believe that the horror of an actual nuclear detonation, even if inadvertent, would strengthen the global taboo against nuclear weapons use and make future use less likely.[135]

Regarding the scenario where no inadvertent detonation occurs:

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[130] "It would undermine the confidence in NC3 systems, crisis management, and risk reduction measures."
[131] "Shortly after an inadvertent launch, the mistake would be realised. The target country would be notified and all efforts made to intercept the missile and accept all responsibility. An escalatory cycle would be suicidal, so there is still a high chance that level heads would prevail."
[132] "In case of inadvertent non-test detonation, the global political and cultural shock would be high enough to increase again the threshold of using nuclear weapons."
[133] "If an inadvertent nuclear detonation does not happen, even then it does not eliminate the underlying risks and vulnerabilities associated with nuclear weapons. Technological, organizational, and geopolitical factors would continue to pose challenges to nuclear security, and the potential for human error, technical malfunctions, or cyberattacks remains ever-present. The probability of a nuclear catastrophe may remain relatively constant if underlying risks are not adequately addressed."
[134] "States would increase vigilance, reinforce additional protocols, and improve communication to prevent inadvertent non-test detonation." "Again, I feel that kind of event would serve as a wake up call, and make nuclear powers change their way of looking and the command and control of the weapons. Of course whatever the political instability that allowed the event to occur would need to be addressed or it might happen again."
[135] "If this happened, it would teach the nuclear weapon states a lesson and they would take measures to reduce the risk of a nuclear catastrophe happen again. The public opinion would have a strong impact on this reduction of probability."

- Very few respondents argue that the absence of an inadvertent detonation would increase the risk of nuclear catastrophe. Those who do typically have specific scenarios in mind where they believe an inadvertent use might have led to positive changes in the international system.[136]
- Some respondents argue that the absence of an inadvertent detonation by 2030 would not significantly affect the overall risk of nuclear catastrophe by 2045. These forecasters often believe that other factors, such as intentional use or larger geopolitical trends, are more important in determining the overall risk.[137] They may view the possibility of inadvertent use as just one of many potential pathways to catastrophe, and not necessarily the most likely one.[138]
- Many respondents argue that if no inadvertent non-test detonation occurs by 2030, the overall risk of nuclear catastrophe by 2045 would be lower. They reason that avoiding such an incident would preserve strategic stability, maintain confidence in command and control systems, and allow more time for arms control efforts and improved safety measures.[139] Some note that the absence of an inadvertent detonation would indicate that existing safeguards are working, potentially leading to reduced tensions and lower alert levels.[140] Others argue that avoiding an inadvertent use removes one of the more likely pathways to nuclear catastrophe, thus necessarily reducing the overall risk.[141]

Deliberate non-test nuclear detonation

Question

- What is the probability of a deliberate non-test detonation of a nuclear weapon occurring before the 1st of January, 2030?
- (See detailed resolution criteria and notes here)

Probability of event occurring

	Experts				Superforecasters			
	N	Median	25th%	75th%	N	Median	25th%	75th%

[136] "In case of inadvertent non-test detonation, the global political and cultural shock would be high enough to increase again the threshold of using nuclear weapons."
[137] "An inadvertent non-test detonation is unlikely to impact the probability of a nuclear catastrophe given that such a situation may not cause as much destruction, when compared to an intentional detonation, and not have the same retaliatory geopolitical ramifications as an intentional missile launch might."
[138] "If inadvertent use does not occur, while that makes up some of the potential paths I see to catastrophes, most pathways I see involve deliberate use, so my overall estimate is only slightly lower."
[139] "If inadvertent strikes does not happen, I will also consider that it is because communication (Including crisis communication) channels have been re-established between nuclear communities of different States, and AI has not been integrated too much in decision-making processes. Thus the risks of a nuclear catastrophe is highly decreasing."
[140] "Accidental nuclear detonations are extremely rare events due to stringent safety protocols and safeguards in place in nuclear arsenals worldwide. The absence of such an event is consistent with historical trends and the effectiveness of safety measures."
[141] "I believe the major reason for nuclear catastrophe is an inadvertent nuclear firing, and if this not happening, the risk would substantially be reduced."

Deliberate non-test detonation	110	1%	0.1%	10%	41	0.5%	0.1%	2%

Table A29: *Summary of participant views on probability of a deliberate non-test nuclear detonation by 2030.*

Arguments for very low probability (<0.1%):

- Those who forecast a very low probability of deliberate detonation emphasize the strength of nuclear deterrence and the catastrophic consequences of nuclear use.[142] They argue that the concept of mutually assured destruction remains a powerful deterrent, and that no rational actor would risk the destruction of their own society for any potential political or military advantage.[143]
- These forecasters point to the strong international norms against nuclear use, reinforced by treaties and agreements.[144]
- They also highlight the extreme caution exercised by nation-states in nuclear command and control, considering the gruesome consequences and social, political, and economic repercussions of nuclear use.[145]
- Some argue that even irrational actors would weigh their choices before inviting mutual destruction, and that the advancement in monitoring capabilities makes deliberate use even less likely.[146]

Arguments for low probability (0.1% to 1%):

- Forecasters in this range acknowledge the strength of deterrence but recognize slightly higher risks.[147] They point to ongoing conflicts involving nuclear-armed states and the potential for escalation.[148]

[142] "A retaliatory nuclear strike is inevitable. No country can risk a nuclear weapon hitting its soil. The enormity of the decision of a strike will prevent this from happening."
[143] "Which actor of all those in power today would risk a deliberate first use of nuclear weapons? The stakes are too high. First and deliberate use of nuclear arms ensures immediate and sure annihilation in return."
[144] "Different regimes and treaties are also in place to prevent states from doing so." "All nuclear doctrines, with the exception of Pakistan's since they consider multiple low-intensity scenarios as justifying the use of nuclear bombs, take a defensive approach to nuclear weapons and not an offensive one (i.e. nuclear weapons are simply for deterrence purposes)."
[145] "Nuclear weapons command and control is a nation-state prerogative and they are extremely cautious towards any such act."
[146] "Finally, even irrational actors such as North Korea do not consider nuclear weapons lightly. While Kim Jong Un has been actively threatening the US and South Korea, but it has not yet considered a deliberate non-test detonation."
[147] "Significant risks of deliberate limited nuclear use exist in all of the major nuclear dyads today, even as the absolute risk level is relatively small (though not negligible). Paired with growing geopolitical friction and a lack of arms control or other restraint, the prospect for deliberate nuclear use is likely greater than accidental or inadvertent nuclear detonations."
[148] "Given the nature of geopolitics and the potential for conflict between nuclear powers, deliberate use in the context of a conflict is possible."

- Some mention the possibility of limited use of tactical nuclear weapons in specific scenarios, such as Russia in Ukraine, North Korea in a desperate situation, or Israel against Iran.[149]
- These forecasts often consider the historical precedent of non-use since World War II but recognize that geopolitical tensions and the presence of multiple nuclear powers increase risks slightly.[150]

Arguments for moderate probability (1.1% to 20%):

- Those predicting moderate probabilities often cite current geopolitical tensions, particularly the Russia-Ukraine conflict, as potential flashpoints.[151] They argue that the development of "low yield" or tactical nuclear weapons might lower the threshold for use.
- Some mention the possibility of nuclear use for signaling or demonstrative purposes, potentially over unpopulated areas.[152]
- These forecasts often consider conflicts between India and Pakistan, North Korea and its neighbors, or China and Taiwan.[153]
- Some argue that the erosion of arms control agreements and the modernization of nuclear arsenals contribute to increased risks.[154]

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[149] “While highly unlikely, I think there is a risk that Israel could decide to use a low yield nuclear weapon against either Iran and particularly their nuclear installations.” “This accounts for the low chance that Russia uses nuclear against Ukraine, but I would assume it will be only a limited use of tactical nuclear weapons at chosen vulnerable inhibited targets rather than a use of strategic weapons causing mass casualties.” “"it is not a thing a sane man would do" - but a desperate man might.”

[150] “The deliberate non-test detonations only occur during WW2.”

[151] “There are several ongoing military conflicts involving nuclear weapon states that can decide to use nucs in some critical situations, especially use of tactical nuclear weapons.” “Ongoing military conflicts always carry the chance to be escalated.”

[152] “While China might have a nuclear non-first use policy, I do not find this credible and I think that the PRC would more likely opt for a nuclear signalling in the maritime domain, possibly even without any personnel of material casualities, just to show the psychological willingness to use nukes.” “(1) Much more likely to be a small nuke than a large one. (2) Could also target an unpopulated area, and announced in advance, as a demonstration of resolve.”

[153] “The US IC [intelligence community’ has been as high as 50% that Russia would detonate a nuclear weapon during their invasion go Ukrainian, when Russia was quickly and humiliating losing ground and the Kerch Strait Bridge had been partially sunk. It was not an existential risk for the country of Russia, but if Russia had been quickly routed in Ukraine, including Crimea, it could have been an existential risk for the survival of Putin and those in his inner circle. Facing such a threat, a tactical nuke or even a nuclear test on the territory of Russia would have a certain logic as a last ditch effort to stop Russian losses in Ukraine. Since this threat has passed and Ukraine has not been provided adequate equipment and munitions to succeed agains Russia, the nuclear risk has declined in the short term. In the long term, if Russia overwhelmingly prevails in Ukraine it will provide strong evidence that nuclear blackmail works, and will destabilise the region. This is likely to increase the number of countries seeking nuclear weapons and may embolden China to attempt to take Taiwan - which would be another very high stakes war. A chance exists that Pakistan or India will use a nuke in hostility, but his is unlikely unless India attempts a major invasion of Pakistan.”

[154] “While the probability of nuclear catastrophe remains low, the risk of deliberate non-test detonation has increased recently due to growing trend of developing counterforce nuclear capabilities. States are preferring more flexible nuclear strike options that increases the probability of deliberate non-test detonation to a higher level as compared to deliberate all-out or massive strike.”

Arguments for high probability (>20%):

- Forecasters predicting high probabilities express significant concerns about current global tensions and the potential for rapid escalation. They may view deliberate use as the most likely pathway to nuclear catastrophe.
- Some cite specific scenarios, such as Russia feeling existentially threatened in Ukraine, or China considering nuclear options in a Taiwan conflict.[155]
- Some argue that the taboo against nuclear use has been weakened by recent events and rhetoric.[156]
- They also factor in the possibility of multiple crisis scenarios unfolding simultaneously, increasing overall risk.[157]

Expected impact on risk of nuclear catastrophe

	Experts				Superforecasters			
	N	Median relative risk	25th%	75th%	N	Median relative risk	25th%	75th%
Inadvertent non-test detonation	87	4.1	1.5	31.3	37	6.7	1.7	16.7

Table A30: *Summary of participant views on change in risk of nuclear catastrophe, conditional on an inadvertent non-test nuclear detonation.*

Arguments for increased probability of nuclear catastrophe if a deliberate non-test detonation occurs:

- Many argue that a deliberate non-test detonation would increase escalation risk. Once the nuclear threshold is crossed, there's a high likelihood of retaliation and further

[155] "I don't see Russia's war in Ukraine going much further than 2030, but I do see Putin getting desperate and potentially resorting to nuclear use. He had eluded to (in a very roundabout eay) using chemical weapons at the start of the war and there are rumors of chemical attacks violating the Chemical Weapons Convention occurring now. (Bulletin of the Atomic Scientists article, March 2024)." "As I mentioned at the beginning, a deliberate detonation is possible and I see coming from Putin's Russia as he's struggling to achieve any long-lasting victory in Ukraine." "
In case of China's aggression against Taiwan, the probability of deliberate non-test detonation would be also above zero."

[156] "Nuclear rhetoric has been introduced back into conversations over conflict zones not only by what was considered to be typical rogue actors but also by Russia, previously considered a "responsible nuclear power."

[157] "Given that the world is becoming increasingly multipolar and the battlefield is becoming more blurred with every passing day, there is half the probability that a deliberate non-test detonation may occur. Democratic backsliding, increasing polarization and technological advancements that may roll out into uncertain circumstances may create an environment where there is 50 percent probability of a non-test detonation."

escalation. Many argue that it would be extremely difficult to prevent a chain reaction of nuclear exchanges.[158]

- A deliberate use would shatter the long-standing nuclear taboo, potentially making future use more likely and "normalizing" nuclear weapons as tools of warfare.[159]
- After an initial nuclear use, states may be more likely to misinterpret conventional attacks as nuclear, increasing the risk of inadvertent escalation.[160]
- Deliberate use would demonstrate a failure of deterrence, potentially encouraging other states to consider nuclear options more readily.[161]
- Nuclear use could lead to a breakdown of the current world order, potentially triggering conflicts in other regions and increasing overall nuclear risk.[162]
- Some argue that nuclear use could spark a new arms race as states seek to bolster their nuclear capabilities in response.[163]

However, some forecasters note that the outcome would depend on the specific circumstances of use, such as whether it was a limited tactical strike or a larger strategic attack, the location of the attack, and how the international community responds.[164]

Arguments for little to no change in probability if a deliberate non-test detonation occurs:

- One forecaster argued that accidental and inadvertent launches are still the most likely scenarios leading to nuclear weapons use. They suggested that deliberate use seems

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[158] “If there is a deliberate detonation, there will be definitely a nuclear war, resulting in a nuclear catastrophe.” “Limited nuclear use may be met with follow-on tit-for-tat, proportionate attacks, which in turn could prompt greater nuclear use.”

[159] “[D]eliberate nuclear use before 2030 could significantly weaken the norm of nuclear non-use, making general nuclear war in the 2030-2045 more likely.”

[160] “[A]fter an initial use of a nuclear weapon, a state may be more likely to perceive conventional attacks as nuclear, increasing the risk of nuclear retaliation.”

[161] “Deterrence has failed once nuclear weapons are used. Failure of deterrence in one situation means that the threat was not credible.”

[162] “A non-provoked nuclear strike would suggest a level of aggressive intent that would result in:
a) immediate retaliatory strike on the part of adversary, even if large part of its nuclear arsenal had been destroyed and/or;
b) immediate retaliation on the part of victim's allies;
c) heighten likelihood of a preventive strike in the middle term involving aggressor and victim's allies, given the heighten expectations of conflict.”

[163] “It might spark a nuclear arms race and open Pandora's box.”

[164] “There is some dependence of the type of target hit during the deliberate detonation to this number, too. There are a few scenarios where you might attempt to use a nuclear weapon on an innocuous target to signal resolve, but most scenarios have nuclear use over tangible military targets---which would be most likely occur in the context of a broader war rather than a "bolt from the blue."” “This question might have been better split into another conditional that specified the intent of the party employing the weapon. If a tactical nuke is detonated, it is likely going to be done by a power that believes it can bring a conflict to a quick end without much fear of retaliation. It raises the possibility of a nuclear catastrophe but does not guarantee it. However, if the detonation happens where it has been used out of a scorched earth policy or because of a miscalculation about retaliation or calculation that 20 million deaths is an acceptable price to pay for the intended outcome, then my overall assessment would be much higher, in the 10-33% range.”

unlikely, so its occurrence or non-occurrence doesn't significantly affect the overall probability.[165]
- Another believed that even if Russia doesn't use nuclear weapons causing mass casualties, there's still a low chance that another potential candidate might use nuclear weapons during the next 30 years.[166]

Arguments for decreased probability if a deliberate non-test detonation occurs:

- One forecaster, while predicting an increase in risk if a deliberate detonation occurred, also mentioned a potential scenario for risk reduction.[167]
- Some forecasters also argued that the revulsion and global outrage following a deliberate detonation could lead to disarmament and avert further nuclear weapons use.[168]

Regarding the scenario where no deliberate non-test detonation occurs before 2030:

- For this scenario, forecasters generally predict a lower probability of nuclear catastrophe by 2045, but opinions vary on how much lower.[169] They argue that the continued absence of nuclear use would further strengthen the taboo against nuclear weapons, potentially reducing future risk.[170] Others argue that the absence of nuclear use could provide opportunities for improved international relations and potentially new arms control agreements.[171]
- However, some forecasters caution that while deliberate use is a major concern, accidental or inadvertent use remains a significant risk factor.[172]

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[165] “Accidental and inadvertent launch are still the most likely scenarios leading to nuclear weapons use. Since deliberate use seems unlikely the overall probability is not affected by deliberate use.”
[166] “I believe that even if Russia does not engage with nuclear weapons taking millions of lives, there is a low chance that one other potential candidate will use nuclear weapons during the next 30 years.”
[167] "That said, the world may take extraordinary steps in response to reduce future risk. For example, I could see widespread global revulsion, and severe diplomatic, economic and military repercussions. That might lead to lower risk in the future, not higher."
[168] “On the one hand, it might spark global outrage and serve as a warning shot that averts a greater tragedy down the road.” “Even after deliberate use of nuclear weapons, the attempt of nations is likely to be to keep it as limited as possible.” “For example, I could see widespread global revulsion, and severe diplomatic, economic and military repercussions. That might lead to lower risk in the future, not higher.”
[169] “Since I consider that the main risks of a nuclear catastrophe lies in a deliberate use of NWs, I would consider that the absence of a deliberate bombing makes the possibilities of nuclear catastrophe highly lower.” “[I]f it does not happen, I wouldn't update my beliefs because that's what I expect.”
[170] “ If it will not happen by 2030 that will mean that most countries understand necessity of keeping nucs just as deterrence measure but not for real use.”
[171] “The efforts towards cooperation to reduce any likelihood of deliberate non-test detonation will increase through diplomacy, strengthening arms control mechanisms and international cooperation.” “[I]f no strikes has happened by 2030, there is a fair chance that the international context might improve and that the risk of nuclear catastrophe decline in the following 15 years.”
[172] “If a deliberate nuclear explosion does not occur, the risk of an inadvertent or accidental explosion remains.”

- Overall, while most forecasters see the non-occurrence of deliberate use by 2030 as reducing the risk of catastrophe by 2045, they often emphasize that significant dangers would persist and require ongoing attention and risk reduction efforts.

A10. Appendix 10: Detail on forecasts on selected 2030 questions relating to conflict and horizontal proliferation

Violent conflict between Russia and the USA

Question

- What is the probability that, by January 1st 2030, there will have been more than 500 deaths in militarized conflict between Russia and the USA in one calendar year?
- (See detailed resolution criteria and notes here)

Probability of event occurring

	Experts				Superforecasters			
	N	Median	25th%	75th%	N	Median	25th%	75th%
500 militarized deaths between Russia and the USA	60	5%	1%	10%	38	1.75%	0.55%	5%

Table A31: *Summary of participant views on probability of 500 militarized deaths between Russia and the USA by 2030.*

Arguments for a higher likelihood of the event happening:

Forecasters focused on the potential for existing or future conflicts to draw in the U.S. and Russia. The U.S. could become more involved in the Ukraine war or Russia's appetite to expand to other NATO countries in the Baltic could lead to conflict with the U.S. In addition, several forecasters mentioned the possibility of U.S.-Russian conflict in Syria, noting the U.S. is already believed to have killed Russian mercenaries in an incident known as the Battle of Khasham, although Russia did not overreact to that incident. Even if neither country wants to go to war with the other, forecasters argued, the increasing involvement of both Russia and the U.S. in global hotspots could lead to misunderstanding or unintended escalation between the two.

Arguments for a lower likelihood of the event happening:

Forecasters noted the base rate of zero and argued that both Russia and the U.S. prefer to avoid direct conflict and engage in proxy conflicts instead. One reason for this is that both countries are aware that a conventional conflict could lead to nuclear war, with the accompanying risk of mutually assured destruction. A conventional conflict would also entail

economic cost and harm to each country's international standing. Russia may not have the military capacity to challenge the U.S. directly, while the U.S. political climate does not support war with Russia. In addition, forecasters noted the established diplomatic communication channels and crisis management mechanisms between the two countries.

Expected impact on risk of nuclear catastrophe

	Experts				Superforecasters			
	N	Median relative risk	25th%	75th%	N	Median relative risk	25th%	75th%
500 militarized deaths between Russia and the USA	50	3.1	1.5	11.8	36	2.8	1.5	12.5

Table A32: *Summary of participant views on change in risk of nuclear catastrophe, conditional on 500 militarized deaths between Russia and the USA.*

Arguments for this event increasing the risk of nuclear catastrophe (relative risk > 1):

Arguments for this event increasing the risk of nuclear catastrophe included the argument that any direct conflict between nuclear powers significantly increases the chances of nuclear escalation. A conventional conflict involves the breakdown of diplomatic relations and increases the risk of miscalculation, misunderstanding, "fog of war," or accident. It could also draw in other nuclear powers and increase the risk of conflicts in other areas of the globe. Forecasters argued that a country that expects to lose in a conventional conflict would be tempted to use nuclear weapons. Several forecasters noted that Russia's military inferiority to the U.S. could motivate it to use nuclear weapons, but one forecaster believed that Russia would be militarily superior to the U.S. in Eastern Europe.

Arguments for this event not having much effect on nuclear catastrophe risk (relative risk ≈ 1):

Forecasters argued that Russia and the U.S. are both highly aware of the risk of nuclear war. Because of mutually assured destruction, the threshold for using nuclear weapons is high for both countries, and they would likely use conventional means of retaliation before turning to nuclear weapons. The base rate of a Russia-U.S. nuclear conflict is zero, despite past proxy conflicts such as U.S.-Russian encounters in Syria. Compared to other nuclear powers, one forecaster argued, Russia and the U.S. have the best safeguards for nuclear weapons handling.

China invading Taiwan by 2030

Question

- What is the probability that China launches an invasion against Taiwan before January 1st, 2030?

- (See detailed resolution criteria and notes here)

Probability of event occurring

	Experts				Superforecasters			
	N	Median	25th%	75th%	N	Median	25th%	75th%
China invades Taiwan	43	25%	10%	45%	12	19%	4%	31.5%

Table A33: *Summary of participant views on probability of China invading Taiwan by 2030.*

Arguments for a higher likelihood of the event happening:

These arguments centered on perceptions of Chinese motivation and capability for invading Taiwan. Forecasters noted the increasing Chinese military budget, including a buildup of nuclear weapons, and increasing Chinese maritime control of seas near Taiwan. Politically, reunification with Taiwan continues to be a stated Chinese goal, and political victories by a pro-independence party (the DPP) in Taiwan could create a Chinese perception that the window of opportunity is closing. Some forecasters argued that American actions to further a closer alliance with Taiwan and provide military support were provocations. The Russia/Ukraine war could take American resources away from a confrontation with China, and a potential loss by Ukraine could increase the Chinese appetite for an invasion.

Arguments for a lower likelihood of the event happening:

Forecasters mentioned the high risk of direct conflict with the U.S., including potential sanctions or even nuclear war. One forecaster argued that lessons from Russia's struggles in Ukraine, such as the cohesive response of Western countries opposing the invasion of Ukraine, might discourage China from an invasion. Forecasters also argued that China might prefer gaining power elsewhere or might need to focus on domestic political or economic issues.

Expected impact on risk of nuclear catastrophe

	Experts				Superforecasters			
	N	Median relative risk	25th%	75th%	N	Median relative risk	25th%	75th%
China invades Taiwan	36	2.3	1.0	5.5	11	1.9	1.3	3.6

Table A34: *Summary of participant views on change in risk of nuclear catastrophe, conditional on China invading Taiwan.*

Arguments for this event increasing the risk of nuclear catastrophe (relative risk > 1):

The majority of forecasters who believed this event would increase nuclear catastrophe risk argued that a Chinese invasion of Taiwan would lead to military conflict between the U.S. and China. They believed that the U.S. and China would prefer conventional conflict, but if China

could not prevail in a conventional war, it might use nuclear weapons to deter further U.S. intervention and take out U.S. carrier groups. Due to the gap in conventional capability, China might face a "use it or lose it" dilemma about its nuclear weapons, and invading Taiwan would be an indication of a high risk appetite for China. Alternatively, the U.S. could resort to nuclear weapons if unable to defend Taiwan conventionally. Even if neither country chose to use nuclear weapons, increased alert levels and heightened tensions could increase the risk of an accidental or inadvertent launch.

The conflict would also increase overall global tensions and could draw in Russia, another nuclear power, or lead to nuclear proliferation in nearby countries such as South Korea or Japan. One forecaster viewed this as "among the most dangerous scenarios that could escalate to global conflict."

Arguments for this event not having much effect on nuclear catastrophe risk (relative risk ≈ 1):

Forecasters who believed this event would not change the risk of nuclear catastrophe often argued that they had already considered the risk of this event in their initial forecast, or that the event was so unlikely it would not change their forecast of catastrophe. They argued that a nuclear exchange between China and the U.S. (as opposed to a conventional conflict or political pressure) was unlikely because the consequences would be too high for both countries. Specifically, China lacks the capability to inflict a second strike on the U.S., while the U.S. commitment to Taiwan in the 1979 Taiwan Relations Act does not promise direct military assistance in case of an invasion. Also, using nuclear weapons on Taiwan itself would devastate the territory considering its small size.

Arguments for this event decreasing nuclear risk (relative risk < 1):

Although there were few arguments in this category, one forecaster suggested that if China quickly succeeds in an invasion of Taiwan, the U.S. might not intervene militarily, reducing risk of a U.S.-China conflict.

Non-state actors acquiring nuclear weapons

Question

- What is the probability that a non-state actor conducts a nuclear weapons test or comes into possession of nuclear weapons before the 1st of January 2030?
- (See detailed resolution criteria and notes here)

Probability of event occurring

	Experts				Superforecasters			
	N	Median	25th%	75th%	N	Median	25th%	75th%

A non-state actor acquires nuclear weapons	110	1%	0.002%	5%	41	0.3%	0.1%	1.4%

Table A35: *Summary of participant views on probability of a non-state actor acquiring nuclear weapons by 2030.*

Arguments for a higher likelihood of the event happening:

Forecasters argued that, due to technological advancements and increased availability of information, such as through AI and large language models, it could become easier for non-state actors to acquire the necessary knowledge and expertise. In addition, potential instability in nuclear-armed states, like Pakistan, North Korea, and Russia, could lead to opportunities for theft or unauthorized transfer of nuclear materials or weapons. Some state actors may be willing to transfer nuclear weapons to non-state proxies for strategic reasons, such as Iran to Hezbollah.

Nuclear security may break down within conflict zones or failed states, and international cooperation on nonproliferation could weaken in an environment of geopolitical tensions.

Arguments for a lower likelihood of the event happening:

Most forecasters believed the likelihood of this event happening was low. Arguments for a lower likelihood included the overwhelming incentive among all nations to prevent rogue actors from acquiring nuclear weapons. There is strong international cooperation on nonproliferation measures, including export control measures, to prevent this event, and nuclear security has increased since the 9/11 attacks. Non-state actors would lack the resources, expertise, technology, and infrastructure to acquire nuclear weapons. It would be difficult to acquire fissile material and to transport or handle it without detection. Forecasters believed that a non-state actor would need multiple weapons and multiple experts, and the risk of losing the weapons would be high.

The risk of a non-state actor acquiring nuclear weapons would be higher if the non-state actor is assisted by a state, such as in the event of a regime collapsing, a rogue military official, or a splinter faction of a state government. However, forecasters noted that people with access to nuclear devices are among the most well-vetted personnel in any national military and unlikely to defect. In addition, even if a terrorist group acquired a nuclear weapon, they would not necessarily be able to keep the weapon or understand how to launch it. They would have more of an incentive to immediately use the weapon than to test it.

Forecasters noted the base rate of zero—no non-state actor has even come close to nuclear weapons despite interest from groups such as Al Qaeda. Groups that pursued weapons of mass destruction had limited success with chemical and biological weapons, but never successfully acquired a nuclear weapon. In addition, forecasters believed that terrorist attacks could be more easily perpetrated through non-nuclear means, such as conventional explosives,

guns, or chemical weapons. Several forecasters noted that a dirty bomb would be easier to acquire than a nuclear weapon as defined in the question criteria.

Expected impact on risk of nuclear catastrophe

	Experts				Superforecasters			
	N	Median relative risk	25th%	75th%	N	Median relative risk	25th%	75th%
A non-state actor acquires nuclear weapons	89	2	1.2	10	39	1.8	1.0	5

Table A36: *Summary of participant views on change in risk of nuclear catastrophe, conditional on a non-state actor acquiring nuclear weapons.*

Arguments for this event increasing nuclear catastrophe risk (relative risk > 1):

Forecasters who believed this event would increase the risk of nuclear catastrophe argued that deterrence does not have the same effect with non-state actors compared to states, since non-state actors may act less rationally and retaliation against them is harder. A non-state actor that acquires a nuclear weapon might be more likely to use it immediately as a weapon of war rather than holding it for its deterrent value. Also, an accidental detonation would be more likely since non-state actors lack sophisticated command and control systems.

A non-state actor's use of a nuclear weapon could be misunderstood as an attack by a nuclear-armed state or could trigger retaliation against states perceived as associated with the non-state actor, leading to wider conflict. A non-state actor's nuclear program could be an indicator of global or local governance breakdowns that open other proliferation pathways.

Arguments for this event not having much effect on nuclear catastrophe risk (relative risk ≈ 1):

Many forecasters stated they considered this event unlikely enough that it did not significantly affect their overall forecasts of nuclear catastrophe; many believed that state actors are the primary drivers of nuclear risk. In addition, a non-state actor that acquired possession of a nuclear weapon would still face significant challenges in detonating it, and even if it could detonate a weapon, a non-state actor would likely only be able to cause a small amount of casualties, decreasing the risk of retaliation.

Iran acquires nuclear weapons

Question

- What is the probability that Iran conducts a nuclear weapons test or comes into possession of nuclear weapons before the 1st of January 2030?

- (See detailed resolution criteria and notes here)

Probability of event occurring

	Experts				Superforecasters			
	N	Median	25th%	75th%	N	Median	25th%	75th%
Iran acquires nuclear weapons	110	25%	15%	50%	41	30%	10%	50%

Table A37: *Summary of participant views on probability of Iran acquiring nuclear weapons by 2030.*

Arguments for a higher likelihood of the event happening:

Arguments for a higher likelihood of this event mentioned Iran's technical capability, specifically mentioning its access to highly-enriched uranium and enrichment technology. Iranian relationships with countries such as Russia, China, or North Korea could also support its development of a nuclear weapon. The collapse of the Joint Comprehensive Plan of Action (JCPOA) and the lack of American diplomatic follow-up could also embolden Iran. Although Ayatollah Khamenei has issued a fatwa against nuclear weapons, he is currently 85 and could be replaced by harder-line elements.

Many forecasters identified a scenario in which Iran felt threatened by Israel or the U.S. as the most likely scenario for Iran testing or otherwise acquiring nuclear weapons. This could occur because of fear that Israel might use nuclear weapons against Iran, especially given the current hard-line Israeli leadership. Donald Trump's reelection could also increase tensions between the U.S. and Iran.

Arguments for a lower likelihood of the event happening:

Forecasters argued that Iran could have developed a nuclear weapon in the past, and has chosen not to for years. This suggests that Iran believes there are benefits to a "nuclear hedging" strategy, which allows Iran to enjoy some of the deterrence benefits of having a nuclear weapon without making itself an obvious target for retaliation. Testing a nuclear weapon would carry a high risk of military retaliation by Israel, as well as further economic sanctions. Only a critical threat to national security, according to this argument, would motivate Iran to test a weapon.

In addition, Ayatollah Khamenei has issued a fatwa against nuclear weapons and this religious doctrine may survive his death. One forecaster argued Iran is on a "slow path to democratization." Diplomatic efforts by other world powers such as the U.S. or E.U. could help incentivize Iran to adhere to norms of non-proliferation. Forecasters also argued that Iran understands that acquiring nuclear weapons could destabilize the wider region.

Expected impact on risk of nuclear catastrophe

	Experts				Superforecasters			
	N	Median relative risk	25th%	75th%	N	Median relative risk	25th%	75th%
Iran acquires nuclear weapons	88	1.5	1.1	3.0	39	1.2	1.1	1.5

Table A38: *Summary of participant views on change in risk of nuclear catastrophe, conditional on Iran acquiring nuclear weapons.*

Arguments for this event increasing the risk of nuclear catastrophe (relative risk > 1):

Most forecasters believed this event would increase nuclear risk due to Israel's policy of preemptively attacking Iran to prevent its acquisition of a nuclear weapon. Iranian testing or possession of a nuclear weapon could also increase the risk of a preventive attack against Iran by the U.S. It could also embolden Iran to use nuclear weapons against Israel, and would likely motivate other states in the region, such as Saudi Arabia, to pursue nuclear weapons. In addition, developing nuclear weapons and delivery systems in a hurry could increase the risk of an accident.

Arguments for this event not having much effect on nuclear catastrophe risk (relative risk ≈ 1):

Some forecasters stated that this event would not have a significant effect because Iran is already treated as a nuclear threat because it is believed to be close to developing weapons. Other experts had already factored this event into their baseline risk assessments.

Forecasters disagreed about whether Iran will act rationally—for example, using nuclear weapons only to prevent a territorial invasion—or less rationally. There were also disagreements about how large Iran's arsenal would be compared to Israel or other nuclear powers, although most forecasters believed a potential Iranian nuclear stockpile would be relatively small, meaning that the nuclear deterrence effect would be asymmetrical between Israel and Iran. The location of a potential nuclear attack was another potential crux: forecasters pointed out that Iran has a relatively less dense population.

Arguments for this event decreasing nuclear risk (relative risk < 1):

While most experts believed this event would increase nuclear risk or not have much effect, some argued that Iran's acquisition of nuclear weapons could increase regional stability through a mutually assured destruction effect.

States other than Iran acquiring nuclear weapons

Question

- What is the probability that any state other than Iran, that is not currently believed to have nuclear weapons conducts a nuclear weapons test or comes into possession of nuclear weapons before the 1st of January 2030?
- (See detailed resolution criteria and notes here)

Probability of event occurring

	Experts				Superforecasters			
	N	Median	25th%	75th%	N	Median	25th%	75th%
Any state other than Iran acquires nuclear weapons	110	5%	0.275%	10%	41	5%	1%	10%

Table A39: *Summary of participant views on probability of any state other than Iran acquiring nuclear weapons by 2030.*

Arguments for a higher likelihood of the event happening:

Arguments for a higher likelihood of this event noted the possibility of a dramatic change in the international relations status quo that could make non-nuclear powers more interested in developing nuclear weapons. Forecasters believed several nations would have the technical and economic capacity to develop nuclear weapons if they chose. South Korea might be motivated to do so if they felt threatened by North Korea or China and lost faith in U.S. extended deterrence. Other forecasters noted that Iranian development of nuclear weapons could motivate Saudi Arabia to follow suit. Belarus's close relationship with Russia could enable it to develop its own weapons.

Arguments for a lower likelihood of the event happening:

Arguments for a lower likelihood of this event noted the short timeline in the question and the fact that no countries are currently known to be pursuing nuclear weapons. Potential new nuclear powers seem to be satisfied with existing security norms and conventional deterrence. Some countries with high technical and economic capacity, such as Japan and Germany, would be constrained by anti-nuclear public opinion. Also, a potential new nuclear power would need help from existing nuclear powers, who aren't incentivized to promote proliferation.

The high costs of nuclear weapons also weigh against this event. A country pursuing nuclear weapons would face diplomatic costs, economic costs, and the risk of preventive military action. Nuclear expertise and weapons-grade fissile material is in short supply. Existing non-proliferation norms, IAEA inspections, and other nuclear safeguards would increase the diplomatic cost of pursuing nuclear weapons as well as making it almost impossible to test a weapon without detection. New nuclear powers might see Iran as a negative role model because of the sanctions and diplomatic isolation that country has faced due to its nuclear programs.

Expected impact on risk of nuclear catastrophe

	Experts				Superforecasters			
	N	Median relative risk	25th%	75th%	N	Median relative risk	25th%	75th%
Any state other than Iran acquires nuclear weapons	88	1.3	1.0	2.4	39	1.2	1.1	1.7

Table A40: *Summary of participant views on change in risk of nuclear catastrophe, conditional on any state other than Iran acquiring nuclear weapons.*

Arguments for this event increasing the risk of nuclear catastrophe (relative risk > 1):

Most forecasters believed this event would increase nuclear risk. With more nuclear powers, the risk that nuclear weapons will be used, either deliberately, accidently, or inadvertently, increases. (One forecaster dissented, however, claiming that the number of nuclear powers does not affect the probability of nuclear weapons use.) The risk that a weapon or nuclear expertise could be diverted to a non-state actor also increases. In addition, a new nuclear power would lack experience in safe management of a nuclear arsenal. Furthermore, if a country were motivated to develop nuclear weapons, it would likely be a sign that a neighboring nuclear power was behaving threateningly or had already initiated aggressive military action. Several forecasters mentioned a potential conflict on the Korean peninsula. A new nuclear power could also trigger a regional arms race and undermine the nuclear taboo. Existing deterrence relationships across the world would be destabilized.

Arguments for this event not having much effect on nuclear catastrophe risk (relative risk ≈ 1):

Some forecasters believed that nuclear risk is primarily driven by existing nuclear powers, not by potential new ones. The most likely new nuclear powers (other than Iran) would act rationally and be more interested in deterrence rather than using nuclear weapons for offensive purposes. (However, some forecasters disagreed, believing that a "young" nuclear power would be more inclined to act aggressively than existing nuclear powers.) A new nuclear power would both increase geopolitical tensions and also deter potential attacks. New nuclear arsenals would also likely be small and not affect the fundamental dynamics of deterrence. Furthermore, the taboo on use of nuclear weapons would still apply to a new nuclear power. Some forecasters pointed out that North Korean acquisition of nuclear weapons (and other past new nuclear powers) did not lead to a nuclear conflict.

Arguments for this event decreasing nuclear risk (relative risk < 1):

A new state acquiring nuclear weapons could strengthen the deterrence effect in certain regions and reduce the risk of a conventional conflict escalating to nuclear. This event could also demonstrate the need to reinforce multilateral processes and adopt strengthened measures for nuclear risk reduction. However, these arguments represent a minority view.

Several forecasters noted the uncertainty of trying to understand the circumstances of this event without knowing which country the potential new nuclear power would be.

A11. Appendix 11: Relative risk and forecasts of event occurring of all 2030 crux questions

Relative risk

	Experts				Superforecasters			
Event occurring by 2030	**N**	**Median**	**25th%**	**75th%**	**N**	**Median**	**25th%**	**75th%**
Non-test nuclear detonations								
Accidental non-test detonation	87	1.0	1.0	2.0	37	1.0	1.0	1.1
Inadvertent non-test detonation	88	3.0	1.3	18.5	37	3.0	1.5	10.0
Deliberate non-test detonation	87	4.1	1.5	31.3	37	6.7	1.7	16.7
Nuclear weapons tests								
Nuclear weapons test by North Korea	89	1.0	1.0	1.0	39	1.0	1.0	1.0
Nuclear weapons test by any current nuclear-armed state other than North Korea	89	1.2	1.0	2.0	39	1.1	1.0	1.3
Proliferation								
Iran acquires nuclear weapons	88	1.5	1.1	3.0	39	1.2	1.1	1.5
Any state other than Iran acquires nuclear weapons	88	1.3	1.0	2.4	39	1.2	1.1	1.7
A non-state actor acquires nuclear weapons	89	2.0	1.2	10.0	39	1.8	1.0	5.0
Global number of nuclear weapons is above 15,000	89	1.1	1.0	2.0	39	1.1	1.0	2.0
Technology								
An agreement prohibiting cyberattacks on NC3 systems	88	0.9	0.8	1.0	39	1.0	0.9	1.0
An statement that humans will remain in control of launching a nuclear weapon	89	1.0	0.9	1.0	39	1.0	0.9	1.0
Detectability of SSBNs	89	1.1	1.0	2.0	39	1.0	1.0	1.1
Nuclear and non-nuclear weapons systems become more intertwined	88	1.1	1.0	1.7	39	1.0	1.0	1.2
Nuclear weapons systems become more vulnerable to non-nuclear weapons	87	1.0	1.0	1.7	38	1.1	1.0	1.2
US involvement in international agreements								

	Experts				Superforecasters			
Event occurring by 2030	**N**	**Median**	**25th%**	**75th%**	**N**	**Median**	**25th%**	**75th%**
The US announces its withdrawal from NATO	89	1.2	1.0	3.0	39	1.2	1.0	1.7
The US rejoins JCPOA or similar agreement	89	1.0	0.8	1.0	39	1.0	0.9	1.0
The US announces its withdrawal from the ROKUS treaty	49	1.3	1.0	2.0	15	1.0	1.0	2.8
Conflict involving nuclear-armed countries								
500 militarized deaths between Russia and the USA	50	3.1	1.5	11.8	36	2.8	1.5	12.5
500 militarized deaths between North Korea and the USA	48	1.7	1.0	5.0	15	2.0	1.4	9.0
500 militarized deaths between Russia and a NATO country other than the USA	50	3.0	1.3	7.5	36	1.9	1.2	3.2
500 militarized deaths between North Korea and South Korea	49	1.6	1.0	5.0	15	1.4	1.1	3.0
500 militarized deaths between China and the USA	36	1.8	1.0	5.0	11	2.0	1.2	3.4
500 militarized deaths between India and Pakistan	42	1.4	1.0	3.5	14	1.0	1.0	1.1
China invades Taiwan	36	2.3	1.0	5.5	11	1.9	1.3	3.6
More than 500 conflict deaths due to the Russia-Ukraine conflict in 2029	49	1.0	0.9	1.0	36	1.0	1.0	1.0
A terrorist attack in India that is blamed on Pakistan	42	1.1	1.0	1.6	14	1.0	1.0	1.0
Arms control agreements								
There is an arms control agreement between China and the USA	36	0.8	0.5	1.0	11	1.0	0.9	1.0
There is an arms control agreement between Russia and the USA or NATO	49	0.8	0.5	1.0	36	1.0	0.8	1.0
There is an arms control agreement between India and Pakistan	42	0.9	0.7	1.0	13	1.0	1.0	1.0
There is an arms control agreement between North Korea and the USA or South Korea	49	0.8	0.6	1.0	15	1.0	0.9	1.0
No-first-use policies								
China has a no-first use policy	36	1.0	1.0	1.0	10	1.0	1.0	1.0

	Experts				Superforecasters			
Event occurring by 2030	**N**	**Median**	**25th%**	**75th%**	**N**	**Median**	**25th%**	**75th%**
Russia has a no-first use policy	49	1.0	0.8	1.0	35	1.0	0.9	1.0
The USA has a no-first use policy	78	1.0	0.9	1.0	37	1.0	1.0	1.0
India has a no-first use policy	42	1.0	1.0	1.0	14	1.0	1.0	1.0
North Korea has a no-first use policy	47	1.0	0.8	1.0	15	1.0	0.9	1.0
Pakistan has a no-first use policy	28	1.0	0.9	1.0	2	1.0	1.0	1.0
Summits between adversaries								
There is a summit between Russia and the USA or NATO	50	1.0	0.8	1.0	36	1.0	0.9	1.0
There is a summit between China and the USA	37	1.0	0.9	1.0	11	1.0	1.0	1.0
There is a summit between India and Pakistan	42	1.0	0.9	1.0	14	1.0	1.0	1.0
There is a summit between North Korea and the USA or South Korea	49	1.0	0.8	1.0	15	1.0	1.0	1.0

Table A41: *Summary of participant views on relative change in risk of nuclear catastrophe, conditional on crux events occurring by 2030.*

Probability of event occurring by 2030

	Expert				Superforecaster			
Event occurring by 2030	**N**	**Median**	**25th%**	**75th%**	**N**	**Median**	**25th%**	**75th%**
Non-test nuclear detonations								
Accidental non-test detonation	110	1%	0.01%	10%	41	0.05%	0.01%	0.3%
Inadvertent non-test detonation	110	1.275%	0.1%	10%	41	0.1%	0.01%	0.5%
Deliberate non-test detonation	110	1%	0.1%	10%	41	0.5%	0.1%	2%
Nuclear weapons tests								
Nuclear weapons test by North Korea	110	72.5%	50%	85%	41	60%	40%	85%
Nuclear weapons test by any current nuclear-armed state other than North Korea	110	23.5%	5%	50%	41	12%	5%	25%
Proliferation								
Iran acquires nuclear weapons	110	25%	15%	50%	41	30%	10%	50%
Any state other than Iran acquires nuclear weapons	110	5%	0.275%	10%	41	5%	1%	10%
A non-state actor acquires nuclear weapons	110	1%	0.002%	5%	41	0.3%	0.1%	1.4%
Global number of nuclear weapons is above 15,000	110	35%	10%	51.75%	41	10%	2%	23%

	Expert				Superforecaster			
Event occurring by 2030	**N**	**Median**	**25th%**	**75th%**	**N**	**Median**	**25th%**	**75th%**
Technology								
An agreement prohibiting cyberattacks on NC3 systems	110	20%	5.25%	50%	41	22%	10%	33%
An statement that humans will remain in control of launching a nuclear weapon	110	37.5%	10%	70%	41	6%	2%	30%
Detectability of SSBNs	110	25%	10%	50%	41	20%	7%	50%
Nuclear and non-nuclear weapons systems become more intertwined	110	60%	31.25%	80%	41	50%	27%	70%
Nuclear weapons systems become more vulnerable to non-nuclear weapons	108	60%	32.25%	80%	41	50%	30%	71%
US involvement in international agreements								
The US announces its withdrawal from NATO	110	10%	0.5%	30%	40	5%	2%	12.5%
The US rejoins JCPOA or similar agreement	110	15%	5%	47.5%	41	9%	5%	15%
The US announces its withdrawal from the ROKUS treaty	59	5%	1%	11.5%	16	3.5%	0.875%	5.25%
Conflict involving nuclear-armed countries								
500 militarized deaths between Russia and the USA	60	5%	1%	10%	38	1.75%	0.55%	5%
500 militarized deaths between North Korea and the USA	60	4%	1%	12.5%	16	2%	1%	4%
500 militarized deaths between Russia and a NATO country other than the USA	60	10%	2.825%	32.5%	38	5.5%	1.167%	15%
500 militarized deaths between North Korea and South Korea	60	8%	4.5%	21.25%	16	3.25%	2%	5.25%
500 militarized deaths between China and the USA	43	10%	1.25%	30%	12	6%	2.75%	14%
500 militarized deaths between India and Pakistan	55	20%	5%	50%	14	6.5%	3.5%	22.75%
China invades Taiwan	43	25%	10%	45%	12	19%	4%	31.5%
More than 500 conflict deaths due to the Russia-Ukraine conflict in 2029	60	50%	10%	76.25%	38	46.5%	18%	66.5%
A terrorist attack in India that is blamed on Pakistan	55	60%	47.5%	80%	14	38%	22.25%	53%
Arms control agreements								
There is an arms control agreement between China and the USA	45	10%	1%	20%	12	7.5%	4%	26.5%

	Expert				Superforecaster			
Event occurring by 2030	**N**	**Median**	**25th%**	**75th%**	**N**	**Median**	**25th%**	**75th%**
There is an arms control agreement between Russia and the USA or NATO	60	20%	5%	33.5%	38	10%	6%	34.25%
There is an arms control agreement between India and Pakistan	54	5%	0.1%	13.75%	14	5%	2.25%	9.75%
There is an arms control agreement between North Korea and the USA or South Korea	60	5%	0.078%	11.25%	16	3.5%	1.75%	12.5%
No-first-use policies								
China has a no-first use policy	45	80%	60%	90%	12	71%	46.25%	95%
Russia has a no-first use policy	60	2%	0%	10%	38	2.5%	1%	5%
The USA has a no-first use policy	90	3.5%	0.032%	10%	39	2%	0.5%	5%
India has a no-first use policy	53	70%	20%	90%	14	9.7%	3.875%	86.5%
North Korea has a no-first use policy	60	1%	0%	5%	16	0.75%	0.175%	1.25%
Pakistan has a no-first use policy	55	2%	0%	8%	14	1%	0.175%	7.25%
Summits between adversaries								
There is a summit between Russia and the USA or NATO	60	50%	28.75%	71.25%	38	59%	34.75%	79%
There is a summit between China and the USA	45	70%	50%	90%	12	78%	50.75%	92.75%
There is a summit between India and Pakistan	55	20%	10%	50%	14	22.5%	9.75%	30%
There is a summit between North Korea and the USA or South Korea	60	20%	8.75%	49.25%	16	20%	9.5%	34.25%

Table A42: *Summary of participant forecasts of crux events occurring by 2030.*

A12. Appendix 12: Details of forecasts and rationales for general policies

Crisis Communications Network

Policy

- A secure multilateral crisis communications network is established with all nuclear-armed states participating
- (See detailed resolution criteria and notes here)

Policy rank

	Experts				Superforecasters			
	N	Mean	SD	Prop.	N	Mean	SD	Prop.

				ranking in top 3				ranking in top 3
Rank for implementation	109	3.26	2.03	58%	39	3.03	2.06	62%
Rank for funding	109	2.92	1.81	70%	39	2.41	1.65	77%

Table A43: *Summary of participant rankings for Crisis Communications Network policy.*

Expected impact on risk of nuclear catastrophe

	Experts				Superforecasters			
	N	Median	25th%	75th%	N	Median	25th%	75th%
Relative risk if policy were to be implemented	96	0.75	0.49	0.90	37	0.85	0.71	0.95
Absolute risk reduction if policy were to be implemented	98	-0.85pp	-4.38pp	-0.02pp	37	-0.1pp	-0.65pp	-0.02pp

Table A44: *Summary of participant views on change in risk of nuclear catastrophe, conditional on Crisis Communications Network policy implementation.*

Arguments for forecasts of higher risk reduction:

- A secure communications network would facilitate swift communication between states, reducing the risk of misunderstandings and unintended escalation.[173]
- The network would increase transparency among states and help build trust, which is essential to avoid nuclear catastrophe.[174]
- Past incidents, like the Cuban Missile Crisis, demonstrate how effective communication can prevent catastrophes during times of crisis.[175]

[173] "If this policy get implemented it will significantly reduce the dangers of nuclear catastrophe. One of the major reason that any crisis can escalate to nuclear level is misunderstanding of each others' intentions. With such a strong communication channels in place, misunderstanding or misculculation can be cleared through dialogue between the leaders of two adversarial states over a hotline."

[174] "Implementation of this policy recommendation would enhance rapid and reliable communication, improve crisis management, and facilitate direct engagement between leaders of nuclear-armed states. These actions can help avoid miscalculations that could lead to inadvertent escalation. Inclusion of all nuclear-armed states and non-nuclear states would promote the principles of inclusivity and may encourage a sense of collective responsibility – which would lead to more responsible behavior of the participating states. If there are established protocols for crisis communication, these would reduce the risk of accidental escalation due to miscommunication or misinterpretations. Regular use of the multilateral crisis communications network would build trust among states – which is crucial for reducing nuclear tensions."

[175] "I believe that of all policies, this is the most influential and effective in reducing the risk of a nuclear catastrophe of any kind. My argument is based on the fact that good communication is the key to solving most problems, concerns and challenges. Such a multi-level communication system, which is provided for by the specified conditions of the policy, creates a special level of trust and cooperation necessary to eliminate significant nuclear threats to almost zero. Moreover, as history shows, at decisive moments,

Arguments for minimal impact on risk or even increased risk:

- There is no guarantee that countries would use the network during a crisis. Some states, like China or North Korea, may decide to remain strategically non-communicative.[176]
- A state could use the network to spread misinformation or threaten other states, increasing tensions in some scenarios.[177]
- A communications network doesn't resolve the conflicts that underlie nuclear risk.[178] While nations could use the network to address misunderstandings, communication alone will not prevent deliberate escalation.[179]

Probability of policy being implemented

	Experts				Superforecasters			
	N	Median	25th%	75th%	N	Median	25th%	75th%
Probability of policy being implemented within three years (unconditional)	106	15%	5%	30%	39	10%	4%	25%
Probability of policy being implemented within three years with funding	106	25%	10%	50%	39	18%	6%	36.5%
Funding multiplier	104	1.4	1.1	1.8	39	1.3	1.1	2.0

Table A45: *Summary of participant views on probability of Crisis Communications Network policy implementation*

Arguments for why the policy is likely to be implemented:

when we stood on the brink of, for example, a nuclear war, it was communication that led us away from this catastrophe."

[176] "With the exception of DPRK, physically effective lines of communication, albeit not multilateral across the board ones, already exist. The problem is that no one in authoritarian countries wants to pick up the phone and say anything. So the democracies can reach out and transmit, but the authoritarian states will likely only listen, especially if they are being asked questions about their intentions or what they are doing."

[177] "I think that this would be helpful in certain scenarios, providing reliable redundancy for communications. The less one side has to speculate on what the other side is thinking, the better. Of course, it could just as easily be used as a conduit for misinformation when buying even minutes creates a major strategic advantage. On the whole, however, I think it would be a net mitigation of risk."

[178] "Merely improving the communications connectivity between actor countries does not change the will of the country's leadership and so there will be no effect upon the likelihood of a nuclear incident."

[179] "I think it helps reduce the risk of misunderstandings and/or allows for countries to directly communicate in the event of a crisis. But most of the risk comes from countries deliberately choosing to act, so I don't think it changes things that much."

- Compared to other measures, establishing a communications network is a relatively easy and sensible step to reduce nuclear risk.[180] All nuclear-armed states could benefit from improved communication during crises.[181]
- If a crisis occurs or tensions continue to rise among nuclear powers, states will be motivated to establish such a network.
- Bilateral communication channels already exist. Expanding these channels into a multilateral system is a natural, non-controversial progression.[182]
- States will likely see participation in the network as a net-positive: they gain better diplomatic standing without making significant concessions.[183]

Arguments for why the policy is unlikely to be implemented:

- Tension and mistrust among adversarial powers like the U.S., Russia, and China make cooperation difficult.[184]
- Some states might believe the network infringes on their sovereignty.[185] States with a policy of nuclear ambiguity (like Israel) may resist participation.[186]
- Getting all nuclear-armed states to participate, including North Korea, China, and Russia, seems highly unlikely.[187]
- Without a major crisis to motivate action, states might not prioritize the initiative.[188]

Arguments for why funding is likely to make a difference:

- Funding would reduce financial barriers for participating states and cover the technology and implementation costs.[189]

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[180] "This is a pragmatic option where nuclear armed states do not have anything to lose and this arrangement potentially provides multilateral avenue for crises management which is much needed."
[181] "It would seem to be in every state's interest to have secure reliable communication to other states to resolve crisis. Cost of such a system would be minimal even to small states."
[182] "There is already some communication systems in place, so it will be easier to negotiate about going further."
[183] "Rationale here is similar to the failsafe review: All is a very high bar but it's possible that, if the world zeitgeist evolves so that countries feel they can score diplomatic points by pursuing this policy at little cost, and it doesn't devolve into a situation where one country feels as though they'd be losing face by bowing to the demands of an adversary (maybe it's run through the UN), and it genuinely doesn't compromise any nation's security, it's possible. And at least there's more time than with the failsafe review. Done thoughtfully, I could see a well-funded non-profit moving the needle on this."
[184] "Such a network would require greater trust and cooperation between nuclear weapons states, this seems less likely given the global political environment in the next decade."
[185] "States are more often reluctant to share such information therefore a low probability exists that such mechanism will be functional."
[186] "This is an easier sell, but getting countries to participate would require acknowledgement by the country that it has nukes. That's the biggest obstacle, and no amount of NGO spending is going to make that happen."
[187] "I don't see anti-Western countries, especially North Korea, participating; enough financial incentive might do the trick."
[188] "If world events bring us to a crisis in the next 8 years (assuming that we don't already have some nuclear catastrophe), then there will be a chance for the nuclear-armed states to "step back" and get serious about implementing this communication network. If a non-profit were given a $500M incentive to make this happen, then there is a higher chance."
[189] "A substantial financial investment can significantly enhance efforts to establish a secure multilateral crisis communications network among nuclear-armed states. The $500 million funding could support

- A nonprofit could provide technical expertise and coordinate diplomatic efforts, eliminating a potential collective action problem.[190]
- A nonprofit could secure buy-in by raising awareness and educating states about the initiative.[191]

Arguments for why funding is unlikely to make a difference:

- The main obstacles for implementation are political, not financial. Due to current tensions, non-western states like China and Russia are unlikely to participate.[192]
- Nonprofits have limited influence on the national security decisions of major powers.[193] To succeed, the network needs to be created by a nuclear power, not a nonprofit.[194]
- The proposed $500 million is not significant enough to garner interest.[195]

Failsafe reviews

Policy

- All nuclear armed states conduct a failsafe review
- (See detailed resolution criteria and notes here)

Policy rank

	Experts				Superforecasters			
	N	Mean	SD	Prop. ranking in top 3	N	Mean	SD	Prop. ranking in top 3

initiatives such as technology development, infrastructure deployment, cybersecurity enhancements, training programs, and diplomatic engagements focused on fostering trust and cooperation. By providing necessary resources and expertise, a competent non-profit team could facilitate technical solutions, coordinate diplomatic negotiations, and bridge gaps in mutual understanding and trust. Such initiatives could expedite the establishment of a functional crisis communications network, potentially achieving a high probability of success."

[190] "More realistic than ratifing the CTBT and signing the FMCT. funding can help in organising conferences, trainings and reserches."

[191] "I believe that such a confidence- and security-building measure is of a shared interest among nuclear armed states. Hence, a well-funded NGO might be able indeed to lobby and pressure states, raising awareness of the benefits of crisis communication channels."

[192] "Given current tensions between the US on the one hand and Russia and China on the other, I don't think this will get off the ground. As with all of the questions, I don't think that throwing money at the problem will do much to increase the probability of success. Having attended the Biological Weapons Convention, there are lots of NGOs who do a lot of talking and say interesting things but what ultimately matters are the positions that the countries themselves take."

[193] "This seems out of the purview of something a non-profit team could accomplish. Really the main way the non-profit would help towards this is by training its staff who may then eventually enter government. But I would assume most crisis communication is handled at governmental level."

[194] "NGOs may have limitations in convincing the states to establish such a mechanism. If at all this would happen, it has to be initiated by states themselves, led by the major nuclear states, such as the US."

[195] "Too soon given where we are. $500M is not that much when there are numerous countries with conflicting interests are involved."

Rank for implementation	109	3.83	2.05	50%	39	3.69	2.00	51%
Rank for funding	109	3.48	1.92	61%	39	3.26	1.77	62%

Table A46: *Summary of participant rankings for Failsafe Reviews policy*

Expected impact on risk of nuclear catastrophe

	Experts				Superforecasters			
	N	Median	25th%	75th%	N	Median	25th%	75th%
Relative risk if policy were to be implemented	96	0.80	0.61	0.94	37	0.90	0.75	0.98
Absolute risk reduction if policy were to be implemented	98	-0.5pp	-2pp	0pp	37	-0.099pp	-0.4pp	-0.01pp

Table A47: *Summary of participant views on change in risk of nuclear catastrophe, conditional on Failsafe Reviews policy implementation*

Arguments for this policy reducing nuclear catastrophe risk (relative risk reduction < 1):

- Through the review process, states could identify potential vulnerabilities in their nuclear systems, reducing the risk of accidental or inadvertent nuclear use and malfunctions.[196]
- States could find ways to improve their decision-making processes, preventing miscalculations and unintended escalation.[197]
- Participation by all nuclear powers indicates improved cooperation and greater transparency among nuclear states, reducing the chance of deliberate nuclear action.[198]
- The 2026 deadline incentivizes states to conduct reviews in a timely manner.[199]

[196] "Implementation of this policy recommendation is likely to significantly reduce risk of nuclear catastrophe because of following reasons: 1. The review process would identify potential pathways to inadvertent or accidental nuclear use - such as false alarms, technical malfunctions, and human error. Implementing findings from the review can lead to improved safety protocols, reducing the likelihood of accidental launches. 2. Technical measures, because of the review, can reduce the risk of malfunctions and false alarms. 3. The review would ensure the reliability and security of the nuclear arsenals. This would reduce the risk of unintentional detonations due to maintenance issues."
[197] "Since the greatest risk of nuclear disaster is owing to inadvertent escalation from misperceptions and miscalculations of intent rather than due to issues of technical failure, fail safe reviews will somewhat reduce risks, but other risk factors will still remain."
[198] "The failsafe review would demonstrate that participating countries understand the consequences of an inadvertent launch and are willing to cooperate with others to aviod such an event."
[199] "Comprehensive Risk Identification and Mitigation; While the primary focus is on unilateral actions, the policy also encourages multilateral cooperation where necessary, ensuring a broader scope of risk reduction.; Ensuring needed support for the review process and producing a report by a set deadline (January 1st, 2026) adds a layer of accountability and urgency to the implementation of these measures."

- The policy encourages states to consider emerging AI risks and cyber threats and take steps to mitigate them.[200]

Arguments for this policy not having much effect on nuclear catastrophe risk (relative risk reduction = 1):

- The policy reduces the likelihood of nuclear-related accidents, but accident risk contributes little to the overall probability of catastrophe.[201]
- The main risk of catastrophe comes from intentional nuclear use. The policy does not address the fundamental geopolitical tensions that drive that risk.[202]
- Nuclear-armed states already conduct internal reviews. There is no need to incentivize reviews at a global level.[203]
- The quality and thoroughness of the reviews could vary considerably between states, limiting the effectiveness of the policy.[204]

Arguments for this policy increasing nuclear risk (relative risk reduction > 1):

Probability of policy being implemented

	Experts				Superforecasters			
	N	Median	25th%	75th%	N	Median	25th%	75th%
Probability of policy being implemented unconditional)	105	15%	10%	30%	39	7%	3.5%	16%
Probability of policy being implemented conditional on funding	105	30%	15%	50%	39	10%	5.1%	23%
Funding multiplier	103	1.5	1.2	2.0	38	1.4	1.1	2.0

[200] “Given risks posed by cyber, AI, and that some states continue to follow launch on warning policies, there is a risk that vulnerabilities could be exploited to make a state perceive it was subject to an attack or to compromise the chain of command. Identifying and mitigating these vulnerabilities would reduce risk.”
[201] “Risk of accidental launch leading to a nuclear catastrophe is not very significant. Nuclear armed states already possess adequate technological capabilities to avoid such untoward incident. Although India's accidental missile fire within Pakistan in 2022 indicates that there still such risk, yet the probability of accidental launch of nuclear capable delivery system, already mated with a nuclear warhead, remains very low. Hence, all nuclear armed states conducting a failsafe review shall greatly enhance mutual trust and bolster safety mechanisms mainly to avoid incidents of 'limited' nature, rather than a major catastrophe.”
[202] “Risks are driven by ongoing conflict(s). The risk of an accidental attack are extremely low now, so while this would be a good measure to help get that risk to zero, it's not a direct driver of current risk.”
[203] “Countries have always done this, and will continue to do this.”; “This kind of review/analitycal reports are being done by military authorities in order to keep nuclear arms in agood shape, I guess, and an independent review will have low added value.”
[204] “Even if all nuclear-armed states conduct a failsafe review, there is an open questions of its quality, how such kind of review would be conducted.”

Table A48: *Summary of participant views on probability of Failsafe Reviews policy implementation*

Arguments for why the policy is likely to be implemented:

- Conducting failsafe reviews would benefit all nuclear-armed states by reducing the likelihood of accidental deployments and increasing trust.[205]
- Compared to other risk reduction measures, the policy is uncontroversial and low-risk.[206] States do not have to reduce their nuclear capabilities to participate.[207]
- Wariness of emerging risks like cyber threats and AI could motivate states to participate.[208]
- The policy provides states with an easy avenue to demonstrate responsibility and improve diplomacy.[209] If some states agree to participate, others will follow suit to gain good will.[210]
- Most nuclear powers already conduct internal failsafe reviews, making formal adoption easier.[211]

Arguments for why the policy is unlikely to be implemented:

- The likelihood of all nuclear powers coming to an agreement by 2026 is extremely low due to the lack of trust and cooperation among them.[212]

[205] "I believe there is a lot of benefit to be gained for each country individually from conducting the failsafe review, even if they do not collaborate multilaterally. Pushing the benefits of this review when it comes to increasing trusts and reducing the risks of accidental launches could increase the likelihood of its implementation."
[206] "It's not entirely clear to me whether this proposal would come with a standardised methodology and if yes, 1) would nuclear possessor states agree to that, and 2) whether it would be possible to standardise a review across the many different contexts. However, the key elements of this proposal should be desirable and attainable for all countries concerned. It may even be a low-hanging fruit that nations can agree on while key disagreements remain on other issues (e.g. actual reductions). Lastly, a NGO campaign could likely help with building momentum towards this."
[207] "Even without funding they might do as its not very comprehensive, binding, open."
[208] "With the current state of affairs in the world, the rise in disinformation, increased involvement of fake data generation and false positives, there is a greater chance for the risk of an inadvertent launch. Similarly, the threat matrix for the communication systems has also increased due to the increased efficacy of cyberattacks. Therefore, it is in the interest of states to review their current antiquated failsafe methods. States realize this without the need for additional funding and will review these failsafe measures."
[209] "this policy is easier to implement as it might send a positive PR message about given countries."
[210] "There is consensus in the expert community that this would be useful. It's not super costly for NWS. So this has good chances of getting done if we make politicians aware of the need to get it done. If USA, France etc go first others may follow as they do not want to seem "irresponsible.""
[211] "I predict that most or all nuclear-armed states already do so, though they may not publicly acknowledge these activities. I note that the linked document explaining these policies does not require public reporting on these activities. The document also uses the term "independent" in an ambiguous fashion. Here, I assume that it refers to an organization that is not part of the organization directly responsible for nuclear command and control, rather than, for instance, and organization independent of the state."
[212] "This would be a time-consuming, resource-intensive, and sensitive process. The overall security, geopolitical and regional security situation are not at a place where a significant progress is achievable on this policy recommendation. However, a non-profit might be able to generate some momentum."

- Countries like North Korea and Israel are unlikely to participate or acknowledge their nuclear capabilities.[213]
- States may worry about revealing sensitive information or vulnerabilities in their nuclear systems through the review process and decline to participate.[214]
- There is no incentive to agree to the policy. A near-catastrophe that reveals the need for more scrutiny around nuclear systems is the only potential motivator.[215]

Arguments for why funding is likely to make a difference:

- A well-funded nonprofit could offer technical assistance and provide organizational support to ensure the reviews are completed by the deadline.[216]
- The nonprofit could raise public awareness and encourage cooperation by all states through negotiations and diplomacy.[217]
- $500 million in funding would generate interest and incentivize participation.[218]

Arguments for why funding is unlikely to make a difference:

- Nuclear states will resist participating due to conflicts with other powers. Funding will not resolve this issue.[219]

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[213] "The proverbial "devil in the details" with this question is *all nuclear-armed states.* In my opinion, Israel, North Korea are essentially non-lobby-able regardless of the amount of money or the skill of relevant policy advisors---even for relatively risk-less and cost-free initiatives like a failsafe review. The governments of Pakistan and India may be slightly more amenable, but still the hurdles are profound in my opinion without a significant mobilization of domestic popular opinion and international popular opinion. Throwing out the possibility of a Nobel Peace Prize to compliant leaders is definitely a plus! (lol)."

[214] "I can't see this being implemented because it might have to reveal secrets that some nuclear states are uncomfortable sharing. I don't quite see how a non-profit with money would get around this issue because money doesn't seem to be the crucial issue."

[215] "A failsafe review would only happen if there was a serious crisis, like the Cuban Missile Crisis. Without a shock effect, the nuclear powers do not feel the need for it."

[216] "A substantial financial investment could bolster efforts to encourage and facilitate comprehensive failsafe reviews among nuclear-armed states. The funding could support initiatives such as technical assistance, international workshops, expert consultations, and joint exercises aimed at enhancing NC3 reliability and safety measures. Moreover, financial resources could incentivize cooperation through diplomatic engagements, capacity-building programs, and multilateral forums focused on nuclear risk reduction. By providing necessary resources and expertise, a competent non-profit team could significantly accelerate the adoption of failsafe reviews, potentially achieving a high probability of success by the target date of January 1st, 2029."

[217] "I do think that such policy reflects the interest of all NWs, and a competent non-profit techical team could facilitate negotiations in this sense."

[218] "Countries participating in a fail safe review could easily coerced into authoring and conducting such a conclusive fail-safe review merely by the non-profit team deciding to simply split four millions dollars amongst the other-than-US participants, giving them a template review key and having the final "been conducted report with results" on their monogrammed letterhead. Easy to complete, accomplish, and publish."

[219] "If the Ukraine War is resolved before 2029, there's a smalll chance such a policy might be implemented. The chance will depend on relations, not spending by a non-profit."

- Nuclear programs are sensitive. States will not want to share information about their weapons or NC3 systems with an external organization.[220]
- States that see value in the policy will most likely implement it without funding.[221]
- States are already conducting these reviews internally, making funding irrelevant.[222]

AI Risk Assessment

Policy

- P5 states 1) jointly develop a risk assessment framework for the use of AI models in nuclear command, control and communication systems, and 2) agree to a moratorium on the use of high-risk AI models in NC3 systems
- (See detailed resolution criteria and notes here)

Policy rank

	Experts				Superforecasters			
	N	Mean	SD	Prop. ranking in top 3	N	Mean	SD	Prop. ranking in top 3
Rank for implementation	109	4.61	2.36	39%	39	4.72	2.62	33%
Rank for funding	109	3.61	2.20	52%	39	3.92	2.33	46%

Table A49: *Summary of participant rankings for AI Risk Assessment policy.*

Expected impact on risk of nuclear catastrophe

	Experts				Superforecasters			
	N	Median	25th%	75th%	N	Median	25th%	75th%
Relative risk if policy were to be implemented	94	0.80	0.60	0.96	37	0.93	0.83	0.98

[220] "Nations have nothing compelling them to take this action. They believe their engineering and design is robust enough to field a weapon and barring any data to the contrary it is better to stay with the assumed operability and protection of the current schema. Money provided to a non-profit would have no impact. No nation will outsource a detailed review of their nuclear weapons systems to a third party and most likely non-profit will be perceived as trying to penetrate and weaken the weapons systems."
[221] "With the current state of affairs in the world, the rise in disinformation, increased involvement of fake data generation and false positives, there is a greater chance for the risk of an inadvertent launch. Similarly, the threat matrix for the communication systems has also increased due to the increased efficacy of cyberattacks. Therefore, it is in the interest of states to review their current antiquated failsafe methods. States realize this without the need for additional funding and will review these failsafe measures."
[222] "There are ongoing tests and simulations. Publicly committing to a failsafe policy for so little money will not change the policy direction."

Absolute risk reduction if policy were to be implemented	96	-0.5pp	-3pp	0pp	37	-0.04pp	-0.2pp	-0.004pp

Table A50: *Summary of participant views on change in risk of nuclear catastrophe, conditional on AI Risk Assessment policy implementation.*

Arguments for this policy reducing nuclear catastrophe risk (relative risk < 1):

- The policy would mitigate many of the risks associated with AI in NC3 systems, including faulty decision-making, accidental launches, and cyberattacks.[223]
- Enactment of the policy would indicate improved collaboration among P5 states and mutual concern over nuclear risks, which lessens the overall potential for catastrophe.[224]
- The policy would encourage human involvement in nuclear decision-making and prevent overreliance on potentially misleading AI-generated information.[225]
- While respondents acknowledge that the policy would reduce AI-related risk, some argue that the reduction would be modest because states do not want to integrate AI into their NC3 systems and other scenarios are more likely to precipitate catastrophe.[226]

Arguments for this policy not having much effect on nuclear catastrophe risk (relative risk = 1):

- Nuclear-armed states are not interested in integrating AI into their NC3 systems or entrusting it with nuclear decision-making.[227]
- The policy doesn't address other pressing risks of nuclear catastrophe, including tensions among world powers.[228]
- Verifying compliance would be difficult, limiting the policy's effectiveness.[229]

[223] "The potential for AI supported nuclear decision making to make mistakes, and for cyber disruption of nuclear decision making and nuclear command and control, are serious risks. I am not sure risk assessment of AI models is the best way to address these risks, but P5 discussion of these subjects leading to an agreement along these lines could reduce these risks."
[224] "Undertaking such an assessment and action will stem from a sense of shared concern which will significantly reduce chance of nuclear disaster."; "Even if monitoring or verification was difficult, the fact that leading nuclear armed states are willing to work toward an agreement on AI and NC3 is a major positive and indicative of the shared interest in avoiding a crisis or conflict arising from these threats."
[225] "I am not particularly worried about countries inserting AI into the chain of nuclear decision-making. This seems highly unlikely, it's not in their interests to do so, and they have all agreed not to do so. I am, however, concerned about the possibility that decision-makers could be influenced by a data-poisoned information environment in the midst of a nuclear crisis. So anything that can be done to mitigate this would be helpful. However, I am skeptical about how possible this will be."
[226] "I do not believe that nuclear states are strongly predisposed to incorporate AI into nuclear weapons employment decision-making, so while this measure would be positive, it likely does not significantly reduce nuclear risks."
[227] "There is no indication that any nation plans to directly integrate AI into NC3 systems, and there are no clear advantages that doing so would provide."
[228] "Again, this would be a nice and prudent measure to reduce risks 30-40 years down the road, but would have no effect on the risk of a nuclear catastrophe in the near term since those risks are driven by the difficult relations between Russia, China, NK, Iran, and the West."
[229] "Similar to Russian violations of the Chemical Weapons Convention and Biological Weapons Convention along with not being able to confirm China's compliance with their treaty obligations,

- All nuclear states, not just the P5, would have to accept the framework and moratorium for the policy to affect nuclear catastrophe risk.[230]
- Some respondents do not consider AI a risk to global security, while others do not know enough about it.[231]

Arguments for this policy potentially increasing nuclear risk (relative risk > 1):

- Several respondents suggest the policy may increase risk. One respondent argues that AI can potentially improve nuclear safety.[232]

Probability of policy being implemented

	Experts				Superforecasters			
	N	Median	25th%	75th%	N	Median	25th%	75th%
Probability of policy being implemented within three years (unconditional)	106	20%	10%	40%	39	9%	3%	21.5%
Probability of policy being implemented within three years with funding	106	30%	10%	53.75%	39	12%	4%	31.5%
Funding multiplier	102	1.5	1.1	1.9	39	1.3	1.1	1.5

Table A51: *Summary of participant views on probability of AI Risk Assessment policy implementation.*

Arguments for why the policy is likely to be implemented:

- World leaders are concerned about the risks associated with AI, which could create momentum for policy action.[233] Some states are already discussing the topic.[234]
- All states would benefit from addressing AI-related risks. The policy creates an opportunity for states to cooperate and confront this threat.[235]

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establishing a framework would not necessarily mean that authoritarian countries are in compliance with such frameworks designed to address these risks."

[230] "The final decision HAS to be of a human and not of an AI system. Must be done by ALL 9 nuclear states and not just P5."

[231] "I disagree that AI models add risk."

[232] "IA models are quickly development and will certainly become a useful tool in many applications. Therefore, it is highly likely they will support nuclear safety. However, as I pointed out before, incidental/accidental events have been very unlikely in the past."

[233] "I think that all countries are more and more concerned about emerging technologies and unknown arising risks from them, notably AI. Since the moratorium touches only high-risk AI, this policy should be acceptable to countries. Risk assessment is also welcomed due to high uncertainty. This policy has good chances of making it."

[234] "This is already being discussed today and some steps are being adopted in order to achieve this. The three main NWS (US, Russia and China) are seeing the benefits on having such a system in place. It is just a matter of time that this will happen."

[235] "AI introduces a new level of uncertainty in nuclear deterrence and war-fighting that all of the P5 nations face. None seems to have an outright advantage at this point, and no one seems to have clear

- While P5 states with advanced AI technology, like the U.S., might be hesitant to enact a policy restricting their technological advantage, states that lag behind, like Russia, will likely support it.[236]

Arguments for why the policy is unlikely to be implemented:

- Distrust among China, Russia, and western powers poses a major obstacle for collaboration and reduces the odds of implementation.[237]
- Given the world's limited understanding of AI, the 2030 timeline is unrealistic.[238] The topic is too complicated and evolving too quickly for states to agree on lasting standards.[239]
- States are struggling to create shared guidelines on AI. These disagreements would only grow more extreme if they took nuclear policy into consideration.[240]

Arguments for why funding is likely to make a difference:

- A nonprofit could facilitate collaboration, accelerating the development of standards and overseeing overall policy implementation.[241]

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solutions to how and when AI will be used. This on-the-horizon technology offers a moment for cooperation among the P5 where clarity about the possibilites of AI use and the conditions under which it is expanded would provide comfort and stability in relations. While non-profits may have less expertise than for-profit companies in this realm, AI policy institutes could make a difference by foreseeing problems and proposing regulations and guidelines for AI use."

[236] "It is likely countries like Russia that are far from AI models development and inclusion into NC3 would be interested in agreeing to this to avoid AI arms race and extra competition in the field they are not (and perhaps won't be) ready for."

[237] "It will be very difficult to get China and Russia to sign on to any joint framework with the Western P5 countries. It is more realistic that Russia and China develop their own framework separately and the Western P5 countries develop a joint risk assessment framework. The money would be helpful in lobbying and helping implementation in the West but would be met with skepticism and worse in Russia and China."

[238] "I don't think policy is moving fast enough to address AI globally, and 2030 is only 5.5 years away. I don't see 500M making much of a difference when it comes to changing the minds of the US, Russia, or China."

[239] "AI is still on the stage of understanding and it is developing too rapid to be able to agree upon it among countries in the nearest future."

[240] "In recent years, states have found it difficult to find common ground with regards to regulation of AI in conventional weapons systems. Considering the value these states attach to their nuclear programs, it is unlikely that use of AI in NC3 systems could be regulated. A non-profit would also, therefore, have no substantial impact."

[241] "Unconditional Forecast (40%): Developing a joint risk assessment framework for AI in NC3 systems requires coordination among nuclear-armed states, which historically involves complex negotiations and differing priorities. The technical challenges of AI transparency and reliability in sensitive military systems add complexity. Without additional funding or focused external support, progress may be slow due to bureaucratic hurdles and differing national security interests. Conditional Forecast (65% with $500 million funding): A dedicated non-profit team with substantial funding could accelerate the development of a consensus framework. Funding could facilitate comprehensive research, technical demonstrations, and diplomatic efforts to align P5 states' interests. The team could leverage resources to engage experts, conduct trials, and address technical and diplomatic challenges effectively. Overall, the likelihood of implementation increases due to enhanced resources, technical expertise, and strategic advocacy

- Funding could pay for research support and technical expertise to inform the framework and structure of the moratorium.[242]
- The nonprofit team could lead lobbying efforts and run campaigns to garner public favor for the policy.[243]

Arguments for why funding is unlikely to make a difference:

- No amount of funding or effort from a nonprofit team could overcome fundamental conflicts among the P5 or the current reluctance of states to cooperate on AI-related matters.[244]
- A nonprofit team is unlikely to influence state-level policy decisions. Russia and China, in particular, will not listen to non-governmental actors on issues of national security.[245]

Comprehensive Test Ban Treaty is Ratified

Policy

- All nuclear-armed states sign and ratify the Comprehensive Test Ban Treaty.
- (See detailed resolution criteria and notes here)

Policy rank

	Experts				Superforecasters			
	N	Mean	SD	Prop. ranking in top 3	N	Mean	SD	Prop. ranking in top 3
Rank for implementation	109	4.35	2.51	41%	39	4.74	2.12	33%
Rank for funding	109	4.69	2.26	28%	39	4.82	1.73	26%

Table A52: *Summary of participant rankings for CTBT is Ratified policy.*

Expected impact on risk of nuclear catastrophe

provided by the funding. These forecasts assume that funding and a dedicated team could significantly mitigate current barriers to policy implementation, enhancing collaboration and technical readiness among P5 states."

[242] "The P5 have shown interest in talking about AI in the P5 process, so there is an established political space and interest in the issue that already exists. Reducing high risk AI in NC3 also benefits the national security interests of the P5 without compromising the nuclear forces posture or capabilities. The exclusion of the other nuclear armed states increases the likelihood of reaching an agreement because it does not touch on the issue of North Korea and 'recognition' of Pyongyang as a nuclear armed state. Futhermore, an injection of funding would provide additional ideas/inputs regarding the structure of a moratorium and expand the political space/create additional political will to reach an agreement."

[243] "Public awareness campaign could hasten the implementation of this policy."

[244] "I am not sure countries are willing to share what they are doing with AI in the military space. Addition money will not change it."

[245] "Same as some previous questions, I can't see today how non-profit teams can have an impact on China / Russia decision making."

	Experts				Superforecasters			
	N	Median	25th%	75th%	N	Median	25th%	75th%
Relative risk if policy were to be implemented	95	0.90	0.67	1.00	37	0.95	0.80	1.00
Absolute risk reduction if policy were to be implemented	97	-0.05pp	-3pp	0pp	37	-0.01pp	-0.254pp	0pp

Table A53: *Summary of participant views on change in risk of nuclear catastrophe, conditional on CTBT is Ratified policy implementation.*

Arguments for this policy reducing nuclear catastrophe risk (relative risk < 1):

- Treaty ratification would prevent nuclear testing in the future, slowing or halting nuclear weapons innovation and reducing the likelihood of an arms race.[246]
- Mutual acceptance of the treaty signals growing norms against proliferation, better diplomatic relations, and willingness to cooperate, curbing the potential of war.[247]
- Enforcement of inspections and monitoring would increase treaty compliance and build trust and transparency among nations.[248]
- North Korea would have to forgo nuclear weapons testing under the policy, potentially improving relations in its region.[249] The treaty would also deter Russia from testing weapons amid the war in Ukraine.[250]
- Due to new norms, smaller countries and non-state actors may decide not to develop their own nuclear arsenals.[251]

[246] "In my opinion, a test ban would lead to a major slowdown in innovation in nuclear weapons, making the countries dependable on older technologies and weapons. This limited resource restricts usability of nuclear weapons."
[247] "A committment not to test among the world's nuclear weapon states is a small signal of nuclear restraint and signals some level of cooperation states so I reduced the probability a small amount."
[248] "The IMS and in situ inspections would be fully available for the international community to implement the treaty, thus increasing transparency and confidence building measures to prevent nuclear testing."
[249] "Ratifying the CTBT impacts nuclear testing; all countries would stop nuclear testing, but subcritical tests are still allowed/permitted under the CTBT. Moreover, there has been a moratorium on testing since the 1990s, so the ratification of the CTBT and its entry into force would mostly mean that North Korea would stop its current nuclear tests. This might lead to better relations between North Korea and other countries, to a certain extent. The ability to conduct subcritical tests continues to feed into research and development, so in that sense a nuclear catastrophe could still be imminent."
[250] "The norm against nuclear testing is fairly strong even without the CTBT to have entered into force. But, there are concerns that Russia might want to conduct a nuclear test as a signal during the war in Ukraine which could increase the risk of nuclear escalation. It all nuclear states were to sign and ratify the CTBT, this would have a positive effect on the norm against nuclear testing and would make it less likely that Russia would conduct a test, therefore reduce the risk of a nuclear catastrophe somewhat."
[251] "Such an outcome would reduce the probability of smaller, less sophisticated actors developing arsenals and therefore eventually using them. However this benefit would be counterbalanced by the risk of encouraging the development of more sophisticated computer-based simulation exercises that dispense with physical testing. This would in turn increase the competitive uncertainly among major actors, unsure of the status preparedness of their potential adversaries."

Arguments for this policy not having much effect on nuclear catastrophe risk (relative risk = 1):

- While the policy would reduce future proliferation, it does not address existing nuclear arsenals, which are already large enough to cause catastrophic damage.[252]
- Most nuclear-armed states already observe a moratorium on testing, so a formal agreement will not reduce risk.[253] Some argue that the treaty would incentivize secret or underground testing.[254]
- The treaty will not prevent nuclear powers from deploying their weapons if the need arises.[255] Additionally, most nuclear powers have already conducted thorough nuclear tests and don't need additional testing to confidently deploy their weapons.[256]
- States could withdraw from the treaty at any moment, limiting its long-term impact.[257]
- The treaty does not address risks of catastrophe beyond deliberate deployment, such as accidental launches, miscalculations, or a non-state actor acquiring weapons.[258]

Arguments for this policy potentially increasing nuclear risk (relative risk > 1):

- Proponents of increased risk argue that the treaty will be difficult to enforce, especially because there are no penalties for violation and countries like Russia, China, and Israel have repeatedly violated international agreements in the past.[259]

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[252] "CTBT is a preventive measure. There are enough warheads that can annihilate the world pop multiple times over (ok, a small exaggeration, but the point remains). For active risk to reduce, we should be actively reducing warheads. CTBT can reduce future warheads but not reduce existing ones."
[253] "Currently all nuclear weapon states are observing volantary moratorium on nuclear testing. Therefore, if CTBT eneter into force as well it will not have much impact on current state of play in the nuclear domain."
[254] "The policy allows nuclear tests underground as many countries have performed already. This will only prevent new countries to test their nuclear weapons recklessly."
[255] "Enforcement would be laughable, if someone has the technology and they want to use it, they will use it (either testing or in anger). If a party is willing to risk 10M lives, expanded international agreements are just job security for overeducated people."
[256] "CTBT primarily focuses on testing to increase the quality/yield of weapons. All major powers (US, Russia, China) have already done significant testing in previous years. As far as Pakistan and India are concerned, both aren't really concerned with testing at the moment with regards to their adversarial relationship."
[257] "The ratification of an international treaty does not always mean implementation. Russia has been devaluing international treaties in its legal system since the constitutional reform in 2020. At least for that reason, Russia would not see CTBT limiting its nuclear posture: from testing to striking. Therefore, my % would remain unchanged."
[258] "The biggest threat isn't a nation state initiating a nuclear attack that would be thwarted by this kind of treaty. It is more likely that a mentally unstable leader or rogue state would take an action. As such, the ratification of this treaty, while overall a positive, I don't think would change the threat analysis." ; "Although the CTBT has not been ratified by major nuclear power (and Russia has withdrawn from the treaty) the major organization to oversee implementation of the treaty is currently funded by even those who have not ratified it, including the United States. The CTBTO has been able to detect illegal tests (in North Korea) and has helped established a norm that reduces testing. In addition, while nuclear testing can help develop and refine nuclear weapons, and may help add weapons to stockpiles, it does not prevent an accidental or intentional loss of nuclear weapons already deployed."
[259] "More countries signing the treaty could give a message of peace and unity through the world, but in the last 5 years we have seen powers like Russia and Israel act against the international law - no treaties nor the UN could stop them, sanctions did not have significant effects on those countries and they continue to operate in impunity. I don't believe it would be different with a nuclear treaty."

- One respondent argues that low-level testing is already happening and is difficult to identify.[260]

Probability of policy being implemented

	Experts				Superforecasters			
	N	Median	25th%	75th%	N	Median	25th%	75th%
Probability of policy being implemented within three years (unconditional)	106	6.5%	1%	15%	39	5%	1%	9.5%
Probability of policy being implemented within three years with funding	106	10%	2.625%	28.75%	39	7%	2%	10%
Funding multiplier	97	1.3	1.0	2.0	36	1.1	1.0	1.4

Table A54: *Summary of participant views on probability of CTBT is Ratified policy implementation.*

Arguments for why the policy is likely to be implemented:

- There is widespread support for the CTBT and many countries have already signed it, increasing the likelihood of it entering into force.[261]
- Growing global conflicts, wariness of nuclear risk, and political pressure could push reluctant states toward ratification.[262]
- A change in leadership in key countries could lead to a shift in policy around the CTBT.[263]
- Countries may see treaty ratification as a low-cost method to demonstrate goodwill.[264]

Arguments for why the policy is unlikely to be implemented:

[260] "Current buildup of China and Russia not due to any violations of the current CTBT or testing banned by the CTBT. The low level testing going on is difficult to identify, let alone to verify to the point where it can be stocked second there are no penalties for violating the tree, even with very low level unverifiable testing."
[261] "Many have signed but not ratified."
[262] "I think several of the countries are not interested in a test ban, but I think political pressure might be enough to get it done." ; "I think states have a strong and growing interest in ratifying the CTBT, so I think there is some likelihood of it entering into force, though also some headwinds. And I think a massive campaign could move the needle modest but meaningfully."
[263] "The war in Ukraine should be over, and Putin may no longer be in power. I think it has less to do with money and more to do with if Strong-Men type leaders are in charge in nuclear-armed states."
[264] "If crises do not escalate further, this might be a policy with relatively low costs on implementation for nuclear armed states."

- Major nuclear powers, including the U.S. and China, still haven't ratified the treaty, while Russia ratified but withdrew. There are no indications of growing favor for the treaty in these countries, making complete ratification unlikely.[265]
- Recent global conflicts have made international cooperation more difficult.[266]
- Some countries view nuclear testing as an integral part of their national security strategy, either to modernize their weapons or as a means of deterrence.[267]
- Domestic political obstacles in certain countries like the U.S. make approval unlikely.[268]

Arguments for why funding is likely to make a difference:

- A funded nonprofit team could lobby and build consensus around the policy, as well as mitigate concerns and address technical challenges.[269]
- Funding could pay for public awareness campaigns about nuclear risks, potentially building support for ratification.[270]
- The U.S. could be positively influenced by a well-funded campaign, and U.S. ratification might lead to a domino effect in Russia and China.[271]

Arguments for why funding is unlikely to make a difference:

[265] "Of the nuclear states, the US and China have signed but not ratified, Russia signed and ratified but then withdrew the ratification, and Pakistan, India and North Korea have neither signed nor ratified. Given the divergent nature of domestic politics in each of the countries in question, and the larger attendant geopolitical jockeying, the likelihood that all will sign on by 2033 is negligible. I don't think 500 M will make much of a difference, given the stakes and the players."
[266] "The geopolitical intricacies and the requirements of the treaty are the main obstacles for the entry into force of this treaty, thus it is unlikely that more funding or advocacy will be a factor to change the current situation."
[267] "Here the problem lies on the modernization of the nuclear arsenals by the US, Russia and China. With new arsenals and new improvemts in explosion devices this countries will need to test them in order to see how effective are."
[268] "All is a very steep target. For the US system, ratification pathways depend on Senate composition in add'n to administration's will, and sadly campaign finance even if it was a permitted use puts this as not a huge sum to swing that many Senate seats. And that's just the US."
[269] "A substantial financial investment can potentially facilitate intensive diplomatic efforts, public advocacy, and technical support needed to persuade and incentivize nuclear-armed states to ratify the CTBT. The funding could support activities such as high-level diplomatic engagements, public awareness campaigns, technical assistance for verification measures, and building international consensus. Such efforts could enhance political will, address technical concerns, and mitigate domestic opposition in key countries. Therefore, with dedicated funding and a competent non-profit team, the probability of achieving universal ratification of the CTBT by 2033 could significantly increase to moderate to high levels."
[270] "To counter the nuclear weapons industry it is necessary to develop a counter narrative highlighting the dangers of more nuclear tests. This can only be done by funding a non-profit team."
[271] "I think that an organization with enough funding would have a chance if they really focused on getting U.S. support for CTBT. If U.S. agreed to ratifying then that would give a chance of Russia coming back to the treaty. With U.S. Russia cooperation on this China could be incentivized to participate and then the rest of the States that haven't ratified in annex 2 could follow."

- Some respondents argue that funding may increase the probability of ratification, but $500 million is not sufficient.[272] Others believe countries that haven't ratified already have considerable power and resources, so funding will not influence them.[273]
- Nonprofit campaigns will likely have no effect on key decision-makers in non-democratic countries, especially if issues of national security are concerned.[274]
- The CTBT Organization is already well-funded but has had limited success in changing countries' positions on this issue. Additional funding will not help.[275]
- Ratification depends more on geopolitical circumstances than advocacy efforts.[276]

Fissile Material Cut-off Treaty is Signed

Policy

- A Fissile Material Cut-off Treaty (FMCT) is signed by all of the P5 countries and India and Pakistan.
- (See detailed resolution criteria and notes here)

Policy rank

	Experts				Superforecasters			
	N	Mean	SD	Prop. ranking in top 3	N	Mean	SD	Prop. ranking in top 3
Rank for implementation	109	5.20	2.45	28%	39	4.90	2.21	31%
Rank for funding	109	5.69	2.24	17%	39	4.95	2.01	18%

Table A55: *Summary of participant rankings for FMCT is Signed policy.*

Expected impact on risk of nuclear catastrophe

	Experts				Superforecasters			
	N	Median	25th%	75th%	N	Median	25th%	75th%

[272] "Money is the driver. I would a collective response to the use. Collective will and money is addressing but not solving the climate change challenge of less then 1,5C. Money needed is significantly more than $500M."
[273] "I think the money would help on the margins, but the most critical actors are state leaders who already have access to power and money, so unclear whether additional funds would make it that useful. Some estimates are that Vladmir Putin is worth a trillion dollars - what is $500 million to a non-profit going to change?"
[274] "Getting the following countries (Israel, Syria, Iran, North Korea, India, Pakistan, Saudi Arabia, China) to sign-ratify the agreement would require a profound settlement of multiple discrete and multiple interconnected political and military differences. It is incredibly unlikely that intervention by a non-governmental organization would move the needle on those issues with these countries."
[275] "With Russia's recent de-ratification of CTBT, it has less chance of becoming relevant again. But given the magnitude of other issues, it still remains a relatively lower hanging fruit. Additional grant would not make much difference because CTBTO already has good budget and spending money on public out reach."
[276] "It is a political and strategic issue, which cannot be resolved by non-profit organizations."

Relative risk if policy were to be implemented	95	0.91	0.78	1.00	37	0.97	0.89	1.00
Absolute risk reduction if policy were to be implemented	97	-0.01pp	-2pp	0pp	37	-0.01pp	-0.1pp	0pp

Table A56: *Summary of participant views on change in risk of nuclear catastrophe, conditional on FMCT is Signed policy implementation.*

Arguments for this policy reducing nuclear catastrophe risk (relative risk < 1):

- FMCT ratification indicates improved relations among nuclear powers, which would lead to greater trust and fewer miscommunications.[277]
- The treaty constrains states' abilities to create new weapons or modernize their arsenals, reducing the likelihood of a future arms race.[278]
- The treaty would slow nuclear expansion in China, Russia, India, and Pakistan.[279]
- Increased oversight would improve safeguards and reduce the likelihood of clandestine production or diversion of fissile materials.[280]
- The treaty incentivizes states to conserve their existing supply of nuclear weapons, potentially reducing aggression and the chances of nuclear launch.[281]

Arguments for this policy not having much effect on nuclear catastrophe risk (relative risk = 1):

- The FMCT limits future weapons development, but it does not address current global stockpiles, which are extensive enough to cause catastrophic damage.[282]

[277] "A fissile material cutoff treaty would be a significant increase in trust among nuclear armed states, and the increased interaction could help to reduce misunderstandings."
[278] "An FMCT would make nuclear arsenal expansion significantly more difficult, costly, and time-consuming. This would prevent or slow numerical increases in nuclear armament, causing corresponding reduction in global threat perception, the likelihood of nuclear use, and the consequences of nuclear use."
[279] "The implement of such an FMCT is important to cap the arsenal size of China, India and Pakistan, thus prevent from further nuclear buildup in those nations. It is also one major step moving forward to nuclear disarmament. However. a global FMCT including all nations (e.g. North Korea , Israel and Iran) will be more effective."
[280] "Since the implementation of this condition requires the replacement of existing safeguards, the strengthening of current data-collecting methods and new level of monitoring, exchanging information between the countries, it may lead to the establishment of more reliable safeguard systems. This has a positive effect on reducing the risks of a nuclear catastrophe." ; "It would help make the world safer because less fissile material could get stolen or used to increase the number of warheads. But it leaves out other countries, including nuclear states like North Korea, which would then be in a prime position in the (black) market. I doubt that North Korea could be solely responsible for a nuclear catastrophe, but it's unlikely the other countries would sell fissile materials anyway."
[281] "Lesser fissile material can impact the postures of both states, becoming relatively lesser aggressive. Such a situation can lead to potentially less narrative of aggression , decreasing the chance of a nuclear catastrophe."
[282] "This does not affect the likelihood of escalation and nuclear weapon states possess enough material/warheads for catastrophic nuclear exchanges."

- The treaty affirms power imbalances among states with robust arsenals and states with small arsenals, which could heighten tensions.[283]
- Many respondents argue that the size of a state's arsenal does not increase the potential of catastrophe. A catastrophic scenario is more likely to result from political tensions, accidents, and miscalculations, which the FMCT does not address.[284]
- There is no guarantee that signatories would comply with the treaty.[285]
- The exclusion of North Korea, Israel, and Iran undermines the treaty's efficacy.[286]

Arguments for this policy potentially increasing nuclear risk (relative risk > 1):

- One respondent predicted that this policy would increase risk because states are continually increasing and advancing their arsenals.[287]

Probability of policy being implemented

	Experts				Superforecasters			
	N	Median	25th%	75th%	N	Median	25th%	75th%
Probability of policy being implemented within three years (unconditional)	106	5%	1%	10%	39	5%	1%	13.5%
Probability of policy being implemented within three years with funding	106	6.5%	2%	15.75%	39	9%	2%	15%
Funding multiplier	97	1.2	1.0	1.8	38	1.1	1.0	1.5

Table A57: *Summary of participant views on probability of FMCT is Signed policy implementation.*

Arguments for why the policy is likely to be implemented:

[283] "There is already enough weapon grade fissile material available with nuclear weapon states, and there is also assymetry in fissile material between states. Therefore, if FMCT is implemented with focus on only stoping future production of weapon grade fissile material it will freez the current assymetry in fissile material among state which is consider as a security threat by many. Unless and untill the treaty do not include the existing fissile material, banning future production will not have a much impact, infact because of assymetries in current fissile mterial stock it will increase the threat of nucear catastrophe."
[284] "Similar to question on CTBT, the risks of nuclear catastrophe are not shaped by the production of more fissile material or increasing number of nuclear warheads per se. Rather, these risks are product of ongoing dynamics of nuclear dyads, force postures, and strategic ambitions of certain leaderships etc. Entry-into-Force of FMCT, especially the one that only aims to stop future production of fissile material for weapons and does not take into account existing stockpiles, shall have no impact on addressing the risks of incidents leading to nuclear catastrophe."
[285] "Even thought these countries would sign this, it doesn't mean that they would necessarily comply."
[286] "I do not see a strong connection between the Fissile Material Cut-off Treaty and the risk of nuclear catastrophe in the current geopolitical conditions. Plus, the proposed policy does not involve the DPRK and Israel."
[287] "Everyone is upping their arsenal, advancements, quantity."

- Increasing awareness of nuclear risks, particularly following the war in Ukraine, could incentivize countries to ratify the treaty.[288]
- Creating fissile material is costly. The treaty helps states avoid incurring those costs.[289]
- Conversations about an FMCT have already occurred, increasing the likelihood of ratification.[290]
- Opposing states with weak arsenals may become more willing to sign in the future after building up their stockpiles.[291]

Arguments for why the policy is unlikely to be implemented:

- The FMCT perpetuates existing imbalances. Pakistan and China are unlikely to sign because they hope to expand their arsenals.[292]
- Some states do not want to publicly share information about their nuclear programs and will resist the treaty's inspection and monitoring requirements.[293]
- Several states are openly opposed to an FMCT.[294] Recent geopolitical tensions have made cooperation even less likely.[295]
- Some states may not see a point in joining unless North Korea and Israel are included.[296]

Arguments for why funding is likely to make a difference:

- Although an FMCT is not currently a priority for global powers, a nonprofit team could raise awareness and build support for the treaty.[297]
- A well-funded nonprofit team could provide technical assistance to implement verification and inspections.[298]

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[288] "In the case of a significant nuclear exchange threat, for example in the context of the Russo-Ukrainian war, bilateral suspicions might be overcome. Outside funding might be a mild inducement."
[289] "I think this is the "easiest" policy to implement. The reason it is "easy" is the cost of creating fissile material is expensive, which means that reducing the amount of fissile material would be a net budget positive for any country."
[290] "This is achievable as it already has been discussed."
[291] "Countries who have only recently joined the nuclear club don't want to be curbed by FMCT at their curret state of development. Over time some of the hold out states may soften their stance as they reach material parity with their neighbors."
[292] "China's nuclear build-up will likely continue into the mid-2030s. India and Pakistan are unlikely to revise their positions on the desirability of an FMCT given their short-term priorities and anxieties."
[293] "States woud be reluctant to disclose information about their fissile material."
[294] "There are such long held opposition to the treaty that I find it difficult to se how that ca be overcome in the P5 environment."
[295] "The regional and international order , with tensions and uncertainty and shifting alliances does not provide a suitable environment for it."
[296] "Russia and perhaps China from the P5 would likely have reservations (if not from the US), and one concern is that North Korea and Israel won't be part of the agreement, which might disincentivize others."
[297] "Unfortunately I think this is fairly unlikely. But there aren't enough people championing it right now, so I do think there's space for a non-profit to increase visibility."
[298] "Unconditional Forecast: Implementing a Fissile Material Cut-off Treaty involves significant political challenges, particularly getting all P5 countries (China, France, Russia, UK, USA) plus India and Pakistan to agree and sign. Historically, progress on FMCT has been slow due to disagreements over verification

- A nonprofit team could finalize the text and requirements of the treaty so more states consent, moving closer to ratification.[299]

Arguments for why funding is unlikely to make a difference:

- Ratification depends on geopolitical circumstances and security concerns, not advocacy efforts. $500 million is not enough to sway states' positions on the matter.[300]
- A nonprofit campaign will not influence China.[301] Pakistan and India are also unlikely to agree to an FMCT given current tensions between them.[302]
- More pressing global concerns are currently occupying the public's attention.[303]
- Well-funded efforts to garner support for an FMCT have had limited success in the past.[304]

USA removes "Sole Authority"

Policy

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methods and existing stockpiles. The extended timeline of 2033 allows for some optimism, but the complexity and geopolitical dynamics involved make achieving full implementation by then uncertain. Conditional Forecast: Providing a non-profit team with substantial funding ($500 million) and a clear mandate to work towards implementing the FMCT could significantly enhance its chances. This funding could support extensive diplomatic efforts, technological developments for verification, and public advocacy campaigns. With dedicated resources, the team could navigate political obstacles more effectively, build consensus among key stakeholders, and address technical concerns promptly. However, even with funding, achieving consensus among all relevant parties remains challenging, hence the cautious increase in probability. These forecasts consider both the inherent difficulties in achieving consensus on FMCT and the potential impact of dedicated funding and focused efforts towards its implementation."

[299] "The Treaty have no final draft, it will be discussed, hopefully, further in order to finalise content and final text. If the team will intensively work on development of approaches and drafting of the Treaty text there will be high probability that concerned states will agree on the text and will begin the signature procedures, but with low probability of readiness to 01.01.2033."

[300] "Too soon given where we are right now. $500M is not that much when there are numerous countries with conflicting interests are involved." ; "Countries will make this decision based on national interest, and a therefore minimally subject to non-profit pressure."

[301] "China. Fissile material production is a precondition for nuclear build-up. China is largely immune to campaigning."

[302] "A Fissile Material Cut-off Treaty would not negatively affect the national security of the P5 states or India or Pakistan. However getting India and Pakistan to agree on any form of conventional or nuclear disarmament would be extraordinarily difficult. Furthermore "fissile materials" is a rather esoteric and obscure topic for the general public---it would be an uphill struggle for an NGO to rise public awareness of U-238 when there are more pressing issues. When dealing with mobilizing popular opinion, I am firmly in the camp of "Keep it simple.""

[303] Ibid.

[304] "The failure of historical efforts to pursue and FMCT suggests it is unlikely to be achieved in the near future. However, representatives of the US State Department have recently spoken positively of such a treaty, indicating the possibility of renewed interest on the international stage. The efforts of a non-profit are likely to have only a minor effect, given that the MacArthur Foundation spent significantly on efforts meant to promote an FMCT, and this appears to have found little success."

- The USA removes the President of the United States' sole authority to authorize the use of nuclear weapons.
- (See detailed resolution criteria and notes here)

Policy rank

	Experts				Superforecasters			
	N	Mean	SD	Prop. ranking in top 3	N	Mean	SD	Prop. ranking in top 3
Rank for implementation	109	6.65	2.25	13%	39	6.03	2.76	28%
Rank for funding	109	6.34	2.28	11%	39	6.36	2.40	18%

Table A58: *Summary of participant rankings for USA Removes "Sole Authority" policy.*

Expected impact on risk of nuclear catastrophe

	Experts				Superforecasters			
	N	Median	25th%	75th%	N	Median	25th%	75th%
Relative risk if policy were to be implemented	96	0.90	0.75	1.00	37	0.97	0.83	1.00
Absolute risk reduction if policy were to be implemented	98	-0.1pp	-1pp	0pp	37	-0.02pp	-0.127pp	0pp

Table A59: *Summary of participant views on change in risk of nuclear catastrophe, conditional on USA Removes "Sole Authority" policy implementation.*

Arguments for this policy reducing nuclear catastrophe risk (relative risk < 1):

- The policy introduces additional checks and balances into the nuclear use authorization process, reducing the risk of impulsive or irrational decision-making by a president.[305]
- Some respondents argue neither Trump nor Biden are fit to authorize nuclear use, and this policy would prevent them from making a catastrophic decision.[306]

[305] "I believe the president of the US is uniquely vulnerable to the dangers of a mental break that could lead to a preemptive nuclear launch. Putting in place another "check" in the system would reduce the danger of one individual making a dangerous decision because of a mental break."
[306] "This would reduce the chance that a delusional president (current examples are Biden in clear cognitive distress and Trump...) makes a suicidal move, but also should be reassuring to Russia that they are not at the mercy of one person going nuts. One could argue that the more complex the process became, Russia could take advantage of the reduced risk of a rapid US response and attempt a decapitation strike. I find that argument absolutely ludicrous because the number of ballistic submarines and widely spread bases, planes and ships throughout the world, as well as land based ICBMS in the US would still make such a preemptive strikes insane."

- By including additional officials in the decision-making process, the policy invites more objectivity and reduces the risk of premature escalation and miscalculation.[307]
- The policy could encourage other nuclear states to adopt similar measures.[308]
- The policy may increase confidence in U.S. nuclear policy and decrease the likelihood of a first strike from the U.S.[309]

Arguments for this policy not having much effect on nuclear catastrophe risk (relative risk = 1):

- Global tensions and accidental launches are more likely to precipitate nuclear catastrophe than U.S. sole authority.[310]
- The policy only addresses nuclear use authorization in the U.S. For greater efficacy, it should also address other countries.[311]
- Multiple advisors are already part of the authorization process in the U.S., despite the illusion of sole decision-making, rendering this policy redundant.[312]
- Military commanders and advisors would intervene during an irrational or unjustified nuclear launch attempt, regardless of whether the policy is implemented.[313]

Arguments for this policy potentially increasing nuclear risk (relative risk > 1):

- The policy would overcomplicate the nuclear use authorization process, compromising the U.S.'s ability to act quickly in times of crises.[314]

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[307] "Eliminating sole authority reduces the risk of premature nuclear escalation and miscalculation by building in time and a check on decision making processes. This would likely reduce risk in certain circumstances, such as a 'fog of war' scenario where a president may move up the escalation ladder to quickly, a premature response to a nuclear accident/unintentional strike, and protect against a mental issue effecting the president's judgement. However, the risk reduction is likely to be slight because several of the most likely flashpoints for a nuclear exchange that would rise to the defined level of catastrophe are not likely to involve the United States (or would not entail a nuclear response from the United States.)"

[308] "This should demonstrate one countries seriousness about controlling the use of nuclear weapons and reduces the potential for miscalcuation by the USA and may be adopted by other nations."

[309] "The policy will have both a direct effect (the authorization of the launch will be less likely), a political effect (the decision will be submitted to different democratic authorities, potentially from different political borders) and international (the threat of use issued by the president would have less effect, and as such a threat of use will not increase as much international tension as it currently does)."

[310] "An accident doesn't depend on US President's powers."

[311] "While such a policy can avoid the risk of a nuclear catastrophe in case of election of a Trump-like President to power, it has no impact on the notions, policy and non-nuclear i.e., conventional weapons' war-like situations under the Presidents orders. Unless the other states in question here also opt-in for a no-first use like provision, there will be no impact on the projected risk."

[312] "Despite presidents sole discretion, many institutions and political actors (National security Advisors) etc are part of the decision making process."

[313] "In practice, decision making will be chaotic, confused and ad-hoc. I also expect that a delusional president will be stopped, no matter the official authority."

[314] "I am changing to "likely to increase risk." The reason for this is that mistakes and poor decision-making under crisis is the way we arrived at both of the close-calls I have cited for my baseline. The Cuban missile crisis and the Able Archer incident were the result of such poor decision-making. If an adversary believes they can inhibit our ability to launch by eliminating one person in the decision-chain, it opens up the possibility that they may believe it is a sufficient advantage to proceed with a preemptive strike. Command and control must be as fast as possible, given delivery of nuclear weapons can be

- Adversaries may consider the policy a sign of weakness and indecisiveness, reducing the credibility of U.S. deterrence and encouraging attacks.[315]
- Non-nuclearized allies may lose confidence in U.S. extended deterrence and seek to develop their own arsenals, increasing risk.[316]

Probability of policy being implemented

	Experts				Superforecasters			
	N	Median	25th%	75th%	N	Median	25th%	75th%
Probability of policy being implemented within three years (unconditional)	107	10%	3%	20%	39	4%	0.5%	10%
Probability of policy being implemented within three years with funding	107	20%	6%	35%	39	5%	1%	16.5%
Funding multiplier	98	1.5	1.2	2.0	35	1.3	1.0	1.9

Table A60: *Summary of participant views on probability of US Removes "Sole Authority" policy implementation.*

Arguments for why the policy is likely to be implemented:

- Given concerns about Biden's mental fitness, the timing for implementation is opportune.[317] Trump's volatility may also increase consensus on restricting presidential authority, depending on the outcome of the 2024 election.[318]

accomplished in a matter of hours or even minutes. This added layer or two will slow that process, even if it is done optimally. This degradation of credible threat and added confusion adds risk, it does not reduce it."

[315] "I suspect the reduction in risk that might occur from preventing a mad/rogue president from launching an unjustified attack would be accompanied by an even greater increase in risk due to US adversaries—both state and non-state—concluding that analysis paralysis or political partisanship would reduce the likelihood that the US would strike back in a timely fashion in the event of a nuclear attack, or strike back at all. This could encourage US adversaries to challenge the US in ways they might not now, potentially leading to misjudgments."

[316] "I do not believe there are major nuclear risks from the POTUS having sole authority to launch nuclear weapons. I think any existing concerns are adequately covered by provisions in the 25th Amendment, or the ability of senior STRATCOM officers to decline illegal orders. However, removing sole authority increases the incentives for US adversaries to consider decapitation strikes, and disinformation / misinformation campaigns during crises. It also increases concerns in allied countries under the nuclear umbrella, and possibly incentivises them to pursue independent nuclear weapons programs. Both increase the risk of nuclear catastrophe."

[317] "Using the current President and his state of mental acuity, visibly noticable gap in situational awareness and apparent cognitive impairment, this President is not currently perceptive enough to control the nuclear football or make time critical commitments of a strategic nuclear nature. Right now would be an ideal time to approach the topic, make recommendations and implement changes. Without instant changes, the USA is in a nuclear crisis every day."

[318] "The upcoming US elections might impact this policy. Currently, the lack of trust in President Biden's mental capacities might pave the way towards the implementation of this policy. Nonetheless, if Trump is

- There is already public support for reducing presidential authority.[319]
- Congress tends to be influenced by public sentiment, increasing the odds of implementation.[320]

Arguments for why the policy is unlikely to be implemented:

- Enacting the policy requires bipartisan support, which is difficult to obtain.[321]
- Presidents want to maintain maximum authority.[322] A sitting president may believe the policy threatens their power and global reputation.[323]
- Republicans want the president to have more authority, not less.[324] If elected, Trump and the Republican Party would resist this policy.[325]
- There is not enough public interest surrounding the issue. Without a crisis to incite public awareness, the policy is unlikely to gain traction.[326]
- Implementation requires restructuring executive governance in the U.S., which Congress will not support.[327]

Arguments for why funding is likely to make a difference:

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re-elected, his volatility might also pave the way towards the implementation of such policy. If the Congress does not have a majority though or if the majority is of the same party as the president, then the implementation might be unlikely."

[319] "US policy is more receptive to pressure from civil society and the idea of removing sole authority is already rather popular in the US."

[320] "US policy is more receptive to pressure from civil society and the idea of removing sole authority is already rather popular in the US."

[321] "While this would require immense bipartisan support within the U.S this seems unlikely given the toxic tribalism in the U.S. However the money might be able to change that."

[322] "Would a president of a nuclear power state ever give up any of his/her powers?"

[323] "I think it is highly unlikely as any US president would oppose such move as it would show him as week and without president's agreement it is unlikely that such policy would be implemented."

[324] "The obstacle here is a worry that the US couldn't respond quickly enough in the event of a massive ICBM first strike on the US. So I think any discussion would quickly get politicized. It also runs counter to the GOP focus on granting POTUS even more power. I'm having trouble imagining how a well-funded non-profit would have much of an impact. Moreover, rightly or wrongly such a non-profit would be labeled as secretly helping Russia or China or both."

[325] "Given that Donald Trump is likely to be the next President of the United States and that he wants the executive to have more rather than less power, it is very unlikely that this gets implemented, unless it is quickly implemented out of fear of a Trump presidency."

[326] "I believe that this is unlikely to happen as it is probably considered to be a minor issue within the US establishment at this stage. Nonetheless, a well-funded NGO might be able to raise awareness across the US population and public and, therefore, lobby politicians." ; "This would only happen if there was a serious nuclear crisis, without such a shock effect it is unlikely to happen."

[327] "In my opinion, despite the ("lower-case 'R'") republican aspirations of population American history, the idea of a monarch-like, sovereign, commander-in-chief is an element platform of "Americanism." It would be a profoundly uphill battle to create a "chain of command" with a European-like "council of leaders" at its head. (A) Presidents of all parties are profoundly unlikely to give up any aspect of executive power, (B) members of Congress of both parties will profoundly defend the current "commander-in-chief" system. Likewise, a plurality or majority of the US public would be hesitant to change from the status quo."

- A nonprofit team could cultivate public awareness and support for the policy through the media, and the public can influence elected officials.[328]
- Congress is particularly susceptible to lobbying, and the nonprofit team could lobby Congress to garner support for the issue.[329]
- A progressive administration could be persuaded by a nonprofit campaign.[330]
- In addition to lobbying and generating awareness, the nonprofit could coordinate research, address concerns, and build consensus around the policy.[331]

Arguments for why funding is unlikely to make a difference:

- Funding cannot change political will.[332] Opponents of the policy will argue it will slow nuclear decision-making during conflict.[333]
- Opponents of the policy will be skeptical of nonprofit involvement and may argue that the organization is working on behalf of U.S. adversaries.[334]
- Article II, Section 2 of the U.S. Constitution poses a significant hurdle to implementing the policy, which a nonprofit cannot change.[335]

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[328] "There are already significant headwinds in this direction and given that the United States remains a democracy, civil society agitating for a change in policy and making this case among political elites and in the media may move the needle. With that said, moving Congress in this direction to overcome a presidential veto is a significant task."
[329] "There are few possibilities that such a measure comes from political authorities in current context, However, a non-profit team could be quite influential in the USA, lobbying specific authorities and parlamentarians as well as influencers (actors). The US sytem would be permeable to such influences/inputs from a non-profit team."
[330] "Highly dependent on the results of the next election. That said, I'm not sure either party truly wants to change the current way of "doing business" when it comes to nuclear weapons. *IF* the Democrats get in full control and *IF* there is political pressure (from a non-profit that "greases the wheels" for example) there is a chance that this kind of policy change can happen."
[331] "The forecast for removing the President of the United States' sole authority to authorize the use of nuclear weapons entails navigating significant complexities and historical precedents deeply ingrained in US national security policy. Without additional funding, the likelihood of implementation is low due to the intricate legal and constitutional challenges involved, coupled with longstanding traditions of presidential authority in matters of defense. However, with a substantial $500 million funding allocation to a competent non-profit team, the forecast improves. This funding could empower extensive research, advocacy efforts, and engagement with stakeholders to build consensus and demonstrate the feasibility of alternative command structures. Such efforts could mitigate political resistance, address national security concerns, and highlight the benefits of a revised command authority framework, potentially increasing the likelihood of policy change."
[332] "recently such a appeal is increasing. If former president Trump is reselected again, such a appeal will be further increasing. Moreover, such a policy is driven mainly by politics , not the funding issues."
[333] "The obstacle here is a worry that the US couldn't respond quickly enough in the event of a massive ICBM first strike on the US. So I think any discussion would quickly get politicized. It also runs counter to the GOP focus on granting POTUS even more power. I'm having trouble imagining how a well-funded non-profit would have much of an impact. Moreover, rightly or wrongly such a non-profit would be labeled as secretly helping Russia or China or both."
[334] Ibid.
[335] "While many in the US might want something like this to happen, the constitutional provision of the President being commander in chief will make this highly unlikely. A non-profit is unlikely to shift the numbers."

A13. Appendix 13: Details of forecasts on some domain-specific policy forecasts

New START Treaty

Policy

The U.S. and Russia negotiate an arms control framework succeeding New START, which expires in 2026.

Policy rank

	Experts				Superforecasters			
	N	Mean	SD	Prop. ranking in top 3	N	Mean	SD	Prop. ranking in top 3
Rank for implementation	28	3.50	2.12	57%	12	3.92	2.50	42%
Rank for funding	28	3.54	2.40	57%	12	4.17	3.13	58%

Table A61: *Summary of participant rankings for USA - Russia New START treaty policy.*

Expected impact on risk of nuclear catastrophe

	Experts				Superforecasters			
	N	Median	25th%	75th%	N	Median	25th%	75th%
Relative risk if policy were to be implemented	25	0.80	0.75	0.91	11	0.95	0.78	0.97
Absolute risk reduction if policy were to be implemented	26	-0.75pp	-2.75pp	-0.03pp	11	-0.04pp	-0.47pp	-0.002pp

Table A62: *Summary of participant views on change in risk of nuclear catastrophe, conditional on USA - Russia New START treaty policy implementation.*

Arguments for this policy reducing nuclear catastrophe risk (relative risk < 1):

- The treaty would improve communication between the U.S. and Russia.[336] As the Cold War exemplified, communication is essential to mitigate nuclear risk.[337]

[336] "HAving the superpowers talking can only reduce the risk. No matter what the deal, as long as they are talking then the risk is reduced."
[337] "Political agreements between the main nuclear power have been key to avoid nuclear catastrophes during the Cold War, and they would surely be key in the future, since they contribute to reduce the speed of the arms race and mantain communication channels always open."

- By requiring both sides to undergo inspections, the policy would build confidence between the U.S. and Russia, potentially stabilizing the relationship.[338]
- Although the U.S. and Russia already have powerful nuclear arsenals, the treaty would constrain future weapons development and prevent an uncontrolled arms race.[339]
- The treaty would set a positive precedent for other nuclear-armed states, especially because Russia and the U.S. have the world's largest arsenals.[340]

Arguments for this policy not having much effect on nuclear catastrophe risk relative risk = 1):

- The policy limits the number of weapons each state can deploy, but the amount permitted under the policy is still sufficient to cause catastrophic damage.[341]
- The policy does not address the risk already posed by each state's existing arsenal.[342]
- Relationships between the U.S. and China or India and Pakistan are more likely to precipitate nuclear catastrophe. To effectively mitigate risk, the treaty must include other nuclear powers.[343]
- The treaty will not prevent either state from deploying weapons during conflict.[344]

Probability of policy being implemented

	Experts				Superforecasters			
	N	Median	25th%	75th%	N	Median	25th%	75th%
Probability of policy being implemented within three years (unconditional)	27	20%	8.5%	35%	12	17.5%	9.25%	30%

[338] "I' conflicted about this one. Arms limits do not translate to risk reduction but the verification and monitoring measurements that come with the treaty are major guardrails for keeping the US-RU relationship somewhat stable."
[339] "The two largest stockpiles would agree to constrain numbers, systems, development and agree upon inspections. The trust to get a treaty signed would be significant."
[340] "Communication & action by the actors with the largest arsenals to reduce their arsenals cooperatively would have the greatest effect on reducing risk. Also, it would set an example for other nuclear-armed actors."
[341] "New START reduces the number of weapons, but not as afar as it should . 1500 nuclear weapons is too much for any country to possess."
[342] "I do not think an increase in warheads/launch systems, if it even happens once New Start is no longer present, will significantly increase the risk of nuclear catastrophe. Both states have enough nuclear weapons today and the quantity of the arsenal only marginally effects escalation risks (given the already existing levels today)."
[343] "China-US or India-Pakistan are far more likely to lead to 10M+ death scenario required for your definition of nuclear catastrophe. Therefore, restraining Russia is unlikely to matter much, espcially since they are too broke and broken (because of Ukraine) to be able to increase their stockpile in any significant manner."
[344] "An extension of NST would be an excellent sign of improvement of relation and willingness to cap competition through regulation. However, if one country wanted to resort to nuclear use following the escalation of a conflict, I don't see how NST may provide guardrails against such use, especially since it would not change deeply the structure of arsenals, policies, …"

Probability of policy being implemented within three years with funding	27	25%	15%	50%	12	20.5%	9.25%	32%
Funding multiplier	26	1.2	1.0	1.5	12	1.1	1.0	1.4

Table A63: *Summary of participant views on probability of USA - Russia New START treaty policy implementation.*

Arguments for why the policy is likely to be implemented:

- The U.S. and Russia both want to avoid the financial costs of an arms race, and this treaty would prevent one from developing.[345]
- The political obstacles that currently impede collaboration between the U.S. and Russia may resolve in the near future, making this new agreement possible.[346]
- Onlooking countries may pressure the U.S. and Russia to enter a new agreement, recognizing that they hold the largest arsenals in the world and pose significant risk.[347]
- Some respondents argue that Trump may want to orchestrate a new agreement to prove his effectiveness in office if elected president.[348] Others believe the likelihood of a new agreement will decrease if Trump is elected president.[349]

Arguments for why the policy is unlikely to be implemented:

- Tensions have escalated between Russia and the U.S. due to the war in Ukraine and the U.S.'s alliance with Europe, reducing the likelihood of a new agreement.[350]

[345] "Assuming that the policy to be implemented is the signing by U.S. and Russia a successor to the New START (It's not specified at the top of this page): With rising expenditures by Russia for conventional weapons, Russia will wish to prevent an arms race with the United States that would be costly, and might not gain much more deterrence value in the war in Ukraine. If the new treaty limited and reduce the U.S. ballistic missile deployment, Russia would be very interested in coming to agreement--even with limits on its nonstrategic nuclear weapons as part of the treaty. The U.S. also has incentives to cap the number of nuclear weapons, including cost and political stability with Russia. Without the New START the U.S. is beginning a program of nuclear build-up, yet military leaders have often said they are not interested in more nuclear weapons--weapons that they cannot use for the most part."
[346] "I view this as in the countries' interest, but current geopolitics, and domestic politics, as being an impediment. In the coming years, I think there is some likelihood the impediments will lessen. And I think a massive campaign could move the needle a little, but probably not a lot, given the other constraints, drivers, etc."
[347] "On one hand, the current situation between Russia and Ukraine is prompting the Russian government to strengthen its nuclear arsenal, making such a treaty very difficult to achieve. On the other hand, the understanding that the USA and Russia are the biggest holders of nuclear arsenals motivates the whole world to push for such a treaty to be signed and ratified."
[348] "I think Trump will want to develop a deal to show he can make deals. It will not be a great deal and will not really help with arms control."
[349] "Depends on the upcoming US Presidential election, again with the likability going down if Trump gets elected."
[350] "With the Russia-Ukraine conflict on going, and with the US taking a very hardened stance along with its European allies. It seems highly unlikely that the US and Russia would come to another arms control agreement."

- Some respondents believe Putin wants to strengthen Russia's nuclear arsenal, not limit it.[351]
- Limiting nuclear armament would contradict the U.S.'s best interests unless the agreement expands to include China.[352] If Trump is elected president, he will not agree to sign without the involvement of other major nuclear powers.[353]
- The U.S. Senate is unlikely to ratify any treaty with Russia given past violations.[354]
- The likelihood of implementation depends on who is leading in either country and how much time has passed since the end of the war in Ukraine.[355]

Arguments for why funding is likely to make a difference:

- There is already support for a new agreement.[356] A well-funded nonprofit could organize a campaign to generate more interest, increasing the likelihood of implementation.[357]
- A competent, well-funded nonprofit team could facilitate U.S.-Russia dialogue.[358]

Arguments for why funding is unlikely to make a difference:

- Russian leaders will be reluctant to accept a new agreement, and a nonprofit will not persuade them otherwise.[359]

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[351] "The New START Treaty expires in 2026. It is probable that the parties will be willing to renegotiate it,. However President Putin does not necessarily see an interest in renewng strategic arms control as he believes that increasing nuclear armament is a key in Russian foreign policy and thus increasing international prestige of Russia."
[352] "China won't play. without China, both countries would be foolish to sign on*. *Unless Russia coordinates with China to use this treaty to intentionally limit the US while keeping China free to expand."
[353] "Trump wanted to let this treaty expire and he is likely to be the President until at least January 2029. I don't think that the Trump administration is likely to listen to non-profits apart from those on the Republican right."
[354] "Given Russia's track record of violating arms control treaties and a range of other international commitments, I found it very unlikely that the US Senate would ratify any treaty with Russia, even if a future US administration were to start and successfully conclude negotiations with Moscow (which is also very unlikely given the significant differences between the positions about the future arms control agenda as well as the general state of bilateral relations). Especially since the sides can simply decide to tacitly observe most of the provisions of New START even after 2026 if that will be in line with their interests (e.g. to avoid arms racing). I'm also very sceptical whether NGO campaigns could succeed in creating more favourable conditions for this."
[355] "Much would depend on how time had passed since the end of the war in Ukraine and who was leading both the US and Russia. Putin and Trump both being in power would not guarantee a new agreement as they both enjoy wagging their nukes to the world."
[356] "Support for a new treaty is strong among some stakeholders but that base if support could be expanded and increased through more funding."
[357] "There is some interest in preserving the Cold War instruments. However, there are also indications that limiting policies might not be of interest anymore. With valid arguments and proper campaigning the likelyhood becomes much higher."
[358] "Russia and USA now passing a confrontation period that probably will be changed for mutual tolerance in next 5-6 years... Hopefully... Active work of the dedicated competent team with sufficient funding can help to facilitate fruitful US-Russia dialog on the Treaty."
[359] "Russia is the one that will need to be brought to the table, and no amount of hand-wringing from nonprofits is going to make that task easier."

- If elected president, Trump is unlikely to be swayed by nonprofits that are not aligned with conservative causes.[360]

China-USA Dialogue

Policy

Policy rank

	Experts				Superforecasters			
	N	Mean	SD	Prop. ranking in top 3	N	Mean	SD	Prop. ranking in top 3
Rank for implementation	10	3.40	2.37	50%	4	3.75	2.36	50%
Rank for funding	10	4.00	2.98	50%	4	4.50	3.70	50%

Table A64: *Summary of participant rankings for China-USA dialogue policy.*

Expected impact on risk of nuclear catastrophe

	Experts				Superforecasters			
	N	Median	25th%	75th%	N	Median	25th%	75th%
Relative risk if policy were to be implemented	9	0.75	0.50	0.80	4	0.88	0.84	0.89
Absolute risk reduction if policy were to be implemented	9	-3pp	-5pp	-2pp	4	-0.225pp	-0.688pp	-0.175pp

Table A65: *Summary of participant views on change in risk of nuclear catastrophe, conditional on China-USA dialogue policy implementation.*

The USA and China would negotiate and sign a bilateral agreement establishing a nuclear dialogue mechanism, outlining its purpose, structure, and procedures.

Arguments for this policy reducing nuclear catastrophe risk (relative risk < 1):

- Regular dialogues between the USA and China would allow both countries' leaders to clarify their intentions and concerns, reducing the potential for misunderstandings.[361]

[360] "Trump wanted to let this treaty expire and he is likely to be the President until at least January 2029. I don't think that the Trump administration is likely to listen to non-profits apart from those on the Republican right."
[361] "Serious discussions between Washington and Beijing - even if not leading to a formal arms control agreement- could significantly reduce misperceptions and misunderstandings between the two powers."

- Routine communication would enhance collaboration between the USA and China on critical nuclear security issues.[362]
- The dialogues would increase transparency and trust between the two countries' leaders, helping them de-escalate any potential crises.[363]
- By consenting to the agreement, China's leaders would demonstrate a commitment to reducing nuclear risk.[364]
- Although all respondents predicted a lower risk of catastrophe under the policy, one respondent noted that USA-China relations do not pose the highest risk of accidental nuclear exchange.[365] Another respondent noted that the dialogues could facilitate a potentially dangerous brinkmanship strategy by China.[366]

Arguments for this policy not having much effect on nuclear catastrophe risk (relative risk = 1):

- No respondents predicted the policy would not affect nuclear risk.

Arguments for this policy potentially increasing nuclear catastrophe risk (relative risk > 1):

- No respondents predicted the policy would increase nuclear risk.

Probability of policy being implemented

	Experts				Superforecasters			
	N	Median	25th%	75th%	N	Median	25th%	75th%
Probability of policy being implemented within three years (unconditional)	10	45%	32.5%	65%	4	13%	4.75%	28.75%
Probability of policy being implemented within three years with funding	10	55%	42.5%	73.75%	4	15%	5%	31.75%
Funding multiplier	10	1.2	1.0	1.3	4	1.1	1.0	1.4

Table A66: *Summary of participant views on change in risk of nuclear catastrophe, conditional on policy implementation.*

[362] "I think the value of ongoing dialogue and standard setting is greatly underrated. It allows regular and unforced communication to become normative, which will innately lead to greater cooperation with respect to nuclear weapons issues."
[363] "Good communication on a regular basis greatly helps to build trust and understanding."
[364] "China agreeing to and actually holding regular high level US-China nuclear talks would indicate that they see more value in having such talks rather using them as a tool to show displeasure with other U.S. actions."
[365] "Since the senior people on both sides will get to know each other, this can be helpful in a crisis. However, I don't think the US-China is the highest risk for an accidental nuclear exchange."
[366] "Again, maybe it will slightly reduce the risk of a nuclear exchange, particularly if a crisis happens. Yet, these crisis are by the very nature exceptional and will usually involve brinkmanship and chicken-game strategies. China is also likely to use the fear of nuclear war in its favor, by pretending that they are not afraid of a nuclear exchange. I tend to think that this measure will somewhat decrease risks, but it is possible to imagine lines of argumentations leading to the opposite conclusion."

Arguments for why the policy is likely to be implemented:

- Both the USA and China have shown a willingness to restore dialogue and diplomacy, as exemplified by Xi Jinping's November 2023 visit to the USA[367]
- China may view the agreement favorably because it would serve as recognition of that country's power on the world stage.[368]
- Regular dialogues are in the best interests of both countries, especially as China seeks to build its nuclear arsenal.[369]
- In the USA, there is already popular support for increasing dialogue with China among the political left and right, increasing the odds of implementation.[370]

Arguments for why the policy is unlikely to be implemented:

- China and the USA have historically struggled to find common ground on military issues. From August 2022 to January 2024, China ceased all military discussions with the USA due to disagreements over US actions.[371]
- Tensions over Taiwan could impede diplomacy between the two countries. To enter into an agreement, China will likely seek assurances regarding Taiwan, which the USA will most likely resist.[372]
- A Trump re-election could reduce China's faith in USA commitments.[373]

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[367] "The November 2023 Summit laid the foundation to such dialogues. Such a policy is beneficial to maintain the strategic stability, in particular, as the bilaterial relations is getting worsen. Such a policy is mainly driven by political will."

[368] "Agreeing to such talks could help portray PRC as "having arrived" as a world power, especially in light of Russia's continuing decline."

[369] "In promotion with China's nuclear build-up, the Chinese leadership may find it in its interest to have a regular nuclear dialogue."

[370] "It's on the table, though support in both nations is extremely tenuous. I'm more optimistic on this as I believe that over the long term this is China's goal, though they would not shy from a path of deep conflict under certain circumstances. Things even moved forward with lukewarm at best civil society support in the US for nuclear dialogue w/China (from both the left and the right, both the arms control and arms race promoting communities), so a strong civil soc. program of work to promote and drive dialogue could make all the difference in things nudging to the positive side."

[371] "I am hopeful this will happen against my better judgement, but I consider it very unlikely given baseline precedent of US / Chinese interactions regarding military issues. For a considerable amount of time, from August 2022 through January 2024, the Chinese cut off all military discussions with the U.S. as a result of various actions taken by the U.S. And given very high tension over anything Taiwan, it is quite likely the US and / or China will find a way to require the other to suspend communications once again. A commitment to ongoing communications by China would almost certainly require explicit guarantees by the US on certain aspects of Taiwan relations and security protections. That seems unlikely at this time since the US is escalating its military assistance and relations to Taiwan to higher levels than they have been in decades. Until we find some way to alleviate these extreme tensions, and given the recent behavior of China regarding even very basic military talks, I think it is very unlikely such an agreement can be completed."

[372] Ibid.

[373] "If Biden is re-elected, he and Xi could build on progress made in Nov 2023. if Trump is elected Xi is unlikelely to have much faith in signing anything as it maybe ripped up again on a whim."

- The given time frame may not be sufficient to successfully implement the policy.[374]
- Hard-line leadership, competition, and suspicion between the USA and China could block implementation.[375]

Arguments for why funding is likely to make a difference:

- Funding could support a number of initiatives to build confidence and trust between the countries, including public awareness campaigns, more frequent Track 1.5 dialogues, data exchanges on nuclear arsenals, and joint exercises on nuclear risk reduction.[376]

Arguments for why funding is unlikely to make a difference:

- Several respondents predicted that funding is unlikely to make a difference, but did not offer their reasoning.

A14. Appendix 14: Domain Specific Policy Results

As the domain-specific policies were answered by different subsets of respondents, and the sample size for each of these domain-specific policies was relatively small, we advise caution in interpreting these results, and particularly in making comparisons across the adversarial domains.

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[374] “This would be a vitally important first step in developing mutual understanding on critical strategic issues. It may be difficult in this time frame, but given China’s buildup and U.S. modernization, both Washington and Beijing may view talks as beneficial.”

[375] “Unconditional Probability (Without Additional Funding) The unconditional probability of China and the USA establishing regular, high-level nuclear dialogue by January 1st, 2029 is estimated to be: 30% Here's why: Mutual Interest: Both countries have a vested interest in preventing accidental nuclear war and managing their nuclear arsenals responsibly. Regular dialogue could help build trust and understanding. Existing Track Record: There have been some "Track 1.5" dialogues between US and Chinese experts on nuclear issues, demonstrating a willingness to engage on the topic, albeit unofficially. Challenges Remain: Several obstacles could impede progress: Strategic Competition: The broader competition between the US and China could make it difficult to find common ground. Domestic Politics: Hardliners in both countries may resist dialogue, viewing it as a sign of weakness. Lack of Trust: A history of suspicion between the US and China could make it difficult to have productive discussions. Conditional Probability (With $500 Million Funding) The probability of establishing regular, high-level nuclear dialogue with a dedicated non-profit team and $500 million might increase to: 40% Here's how the funding could help: Track 1.5 Facilitation: The non-profit team could organize and support more frequent and structured Track 1.5 dialogues between US and Chinese officials and experts. Confidence-Building Measures: Funding could be used to develop and propose confidence-building measures that could pave the way for high-level talks. This might include data exchanges on nuclear arsenals or joint exercises on nuclear risk reduction. Public Education: Campaigns could raise public awareness about the importance of nuclear dialogue, potentially pressuring governments to engage. Rationale These probabilities are based on the potential benefits of nuclear dialogue, the existence of some prior engagement, and the potential for a well-funded team to facilitate more regular and productive discussions. However, the deeply competitive nature of the US-China relationship and historical mistrust could still make establishing regular, high-level dialogue difficult.”

[376] Ibid.

Participants answered questions on three additional policies according to their chosen domain. For each domain there were three policies, except for the domain Russia and NATO, for which there were eight. Out of these eight, a set of three were allocated randomly to participants who chose this domain. Table A76 shows the number of participants who answered on each policy.

Policy	**Experts (N)**	**Superforecasters (N)**
China and the USA		
USA - China conduct regular high-level dialogues	10	4
USA - China missile launch notification agreement		
USA implements “no-first-use”		
India and Pakistan		
India - Pakistan information exchange	28	1
India - Pakistan formalize low-alert status		
India - Pakistan NRRC		
Korean Peninsula		
USA establishes liaison office in Pyongyang	16	4
USA declares no left-of-launch attacks on North Korea		
USA - NK track 1.5 dialogue		
Russia and NATO		
USA - Russia New START treaty	27	12
USA - Russia INF treaty	26	18
Russia decreases low-yield weapons	21	8
USA decreases low-yield weapons	21	8
Russia increases low-yield weapons	16	11
USA increases low-yield weapons	16	11
Russia eliminates “launch on warning”	16	11
USA eliminates “launch on warning”	16	11

Table A67: *Domain-specific policies and number of experts and superforecasters who answered them.*

Similar to the general policies, experts typically thought that domain-specific policies would have a greater impact on the risk of nuclear catastrophe compared to superforecasters. The domain-specific policies caused the median experts to reduce their probability estimates for nuclear catastrophe by 10% to 32% for most policies; the median superforecaster thought that most policies would reduce the risk by 2% to 12%. Note that these reductions are relative and not absolute. Superforecasters were also more skeptical about the probability that policies would be implemented, and about the impact of funding on this probability.

China and the USA

Ten experts and four superforecasters selected China and the USA for the second survey. Both the median expert and the median superforecaster thought the policy that would establish regular high-level dialogue between China and the USA would have the greatest impact on nuclear risk. For the median expert, this policy would lead to a risk reduction of 25%, compared to 12% for the median superforecaster. The median expert thought an agreement between China and the USA to notify each other of ballistic missile launches would decrease the probability of nuclear catastrophe by 20%, and the median superforecaster thought it would decrease the probability by 7%. While the median superforecaster associated the USA implementing a no-first-use policy with a risk reduction of 10%, the median expert didn't think this policy would change the probability of nuclear risk. Table A68 shows the median relative risk.

	Median relative risk (IQR)	
Policy	**Expert (N=9)**	**Superforecaster (N=4)**
USA - China regular dialogue	0.75x (0.5–0.8x)	0.88x (0.84–0.89x)
USA - China missile launch notification agreement	0.80x (0.75–0.84x)	0.93x (0.89–0.95x)
USA implements "no-first-use"	1.00x (0.9–1x)	0.90x (0.78–1.02x)

Table A68: *Policies and relative risk for the domain China and the USA.*

Establishment of regular dialogues between China and the USA was also the policy that the median expert thought was most likely to be implemented, assigning a 45% probability, which increased to 55% with $500 million funding. Superforecasters were less optimistic about its implementation, with the median superforecaster estimating a 13% chance of occurrence (15% with funding). Superforecasters thought a missile launch notification agreement between China and the USA was the likeliest to be implemented, with the median superforecaster forecasting a 32% probability, which increased slightly to 34.5% with funding. Neither experts nor superforecasters thought that the USA was likely to adopt a no-first-use policy, though the

median expert's forecast doubled from 7.5% to 15% with funding. Table A69 shows the median expert's and superforecaster's probabilities for each policy, unconditional and conditional on receiving $500 million funding, and the median funding multiplier (i.e. the proportional increase in the probability of the policy being implemented, conditional on funding).

	Experts N=10			**Superforecasters** N=4*		
Policy	Prob. implementation	Prob. with funding	Median funding multiplier	Prob. implementation	Prob. with funding	Median funding multiplier
USA - China regular dialogue	45%	55%	1.2x	13%	15%	1.1x
USA - China missile launch notification agreement	27.5%	50%	1.3x	32%	34.5%	1.08x
USA implements "no-first-use"	7.5%	15%	1.5x	1%	1.5%	1.05x

Table A69: *Median forecasts for the probability of China and the USA domain-specific policies, unconditional and conditional on the policy receiving additional funding, and median funding multipliers. *Only 2 superforecasters' data is used for the USA implements "no-first-use" policy responses.*

The most popular policy from the China and the USA domain was the establishment of regular dialogues between China and the USA, with an average rank of 3.4 among experts and 3.8 among superforecasters. 30% of experts who answered on this domain ranked this policy first. Ranked for funding, it received an average rank of 4 among experts and 4.5 among superforecasters. A policy for China and the USA to agree on missile launch notifications was ranked slightly less favorably on average, 3.7 by experts and 5.8 by superforecasters. The average rank for funding was 4 for experts and 5.8 for superforecasters. The policy that would have the USA establish a no-first-use policy had an average rank of 6.9 and 6.3 for experts and superforecasters respectively, but these increased to 7.5 for experts and 7.8 for superforecasters when ranking for funding, likely reflecting the skepticism that both groups had about the probability that this policy would be implemented.

India and Pakistan

Twenty-eight experts but only one superforecaster selected the India and Pakistan domain for the second survey. The median expert thought a policy to establish a Nuclear Risk Reduction Center (NRRC) in India and Pakistan would decrease the probability for nuclear catastrophe by 32%. The median expert also believed that policies to formalize a low-alert status of nuclear forces and to exchange information on nuclear and military matters between the two countries would reduce nuclear risk by 30% and 20%, respectively. The one superforecaster who answered for this domain was more skeptical about the values of these policies, suggesting they would result in a 5% to 2% reduction in risk. Table A70 shows the relative risk for the expert and superforecaster group.

	Median relative risk	
Policy	**Expert (N=23)***	**Superforecaster (N=1)**
India - Pakistan information exchange	0.80x (0.56–1x)	0.98x
India - Pakistan formalize low-alert status	0.7x (0.51–0.92x)	0.95x
India - Pakistan NRRC	0.68x (0.49–0.9x)	0.98x

Table A70: *Policies and median relative risk for policies on the India and Pakistan domain. *The India - Pakistan NRRC data is from 24 expert respondents.*

The median expert forecasted a 15% probability that India and Pakistan would establish NRRCs, increasing to 20% with additional funding. They predicted both other policies—an agreement to regularly exchange information and the formalization of a low-alert status—would have a 10% chance of implementation. With funding, the median expert increased their forecasts to 17.5% for information exchanges and to 13.5% for a formal low-alert status. A summary of median forecasts for policy implementation is provided in Table A71.

	Experts N=28			**Superforecasters N=1**		
Policy	Prob. implement ation	Prob. with funding	Median funding multiplier	Prob. implement ation	Prob. with funding	Median funding multiplier
India - Pakistan information exchange	10%	17.5%	1.1x	4%	4%	1x
India - Pakistan formalize low-alert status	10%	13.5%	1.0x	4%	4%	1x
India - Pakistan NRRC	15%	20%	1.3x	4%	4%	1x

Table A71: *Median forecasts for each policy to get implemented, unconditional and conditional on the policy receiving additional funding, and median funding multipliers.*

The formalization of a low-alert status and the establishment of NRRCs ranked 5.6 and 5.7, respectively on average for implementation among experts, with the NRRCs ranking higher on average for funding at 5.6 compared to the policy to formalize a low-alert status at 6.3. A policy for regular information exchanges ranked lower both for implementation and for funding, with average ranks of 6.6 and 6.7, respectively.

Korean Peninsula

Sixteen experts and four superforecasters selected the Korean Peninsula domain for the second survey. The median expert thought the policy that would establish Track 1.5 dialogues between the USA and North Korea would reduce nuclear risk by 20%. Superforecasters thought the impact of this policy would be significantly smaller, with the median superforecaster reducing their risk estimate by 5% conditional on this policy being implemented. If the USA established a liaison office in Pyongyang, the median expert thought that nuclear risk would decrease by 10%. The median superforecaster associated this policy with a 7% relative risk reduction. Of these domain-specific policies, both groups thought a declaration by the USA to conduct no left-of-launch attacks on North Korea would have the least impact on risk, with the median superforecaster thinking that this policy would not impact nuclear risk and the median expert a 10% reduction in risk. Table A72 shows the effects of these policies conditional on their implementation.

	Median relative risk	
Policy	**Experts (N=16)**	**Superforecasters (N=4)**
USA - NK track 1.5 dialogue	0.8x (0.7–0.98x)	0.95x (0.88–0.99x)
USA establishes liaison office in Pyongyang	0.9x (0.78–0.99x)	0.93x (0.83–1x)
USA declares no left-of-launch attacks on NK	0.90x (0.75–1x)	1.00x (1–1.02x)

Table A72: *Median relative risk for experts and superforecasters for policies specific to the Korean Peninsula domain.*

Experts thought, out of the three policies specific to the Korean Peninsula, the establishment of Track 1.5 dialogues is the most likely to be implemented. The median expert forecasted a 12.5% probability for establishment of these dialogues, which increased to 20% with funding. The median superforecaster assigned a forecast of 4% for this policy's implementation. Superforecasters believed the establishment of an American liaison office in Pyongyang was slightly more likely, with an unconditional median forecast of 5% and a median forecast of 7% with funding. The median expert predicted a 10% unconditional probability and 15% probability with funding. Both groups thought a declaration from the USA to not conduct left-of-launch attacks on North Korea was less likely compared to the other two policies. Table A73 shows all probability estimates and median funding multipliers for all policies in the Korean Peninsula domain.

	Experts N=16	**Superforecasters N=4**

Policy	Prob. implementation	Prob. with funding	Median funding multiplier	Prob. implementation	Prob. with funding	Median funding multiplier
USA - NK track 1.5 dialogue	12.5%	20%	1.3x	4%	6.5%	1.0x
USA establishes liaison office in Pyongyang	10%	15%	1.4x	5%	7%	1.01x
USA declares no left-of-launch attacks on NK	5%	12.5%	1.3x	2%	3.5%	1.11x

Table A73: *Median forecasts for each policy to get implemented, unconditional and conditional on the policy receiving additional funding, and median funding multipliers.*

Among the expert group, a policy to establish Track 1.5 dialogues between North Korea and the USA received a mean rank of 5.3 for implementation and 4.1 with funding. Superforecasters on average ranked this policy at 6.8 for implementation and 4.5 with funding. The policy that would involve the USA establishing a liaison office in Pyongyang was ranked lower by superforecasters, with average ranks of 6.0 for implementation and 6.3 for funding. The mean rank from experts for this policy was 6.1 for both implementation and for additional funding. Both groups favored a policy for the USA to declare no left-of-launch attacks on North Korea least of the three, with a mean rank of 6.8 from experts and 7.3 from superforecasters.

Russia and NATO

The eight policies in the Russia and NATO domain were answered by different participants, and the number of answers differ for each policy. We recommend being mindful of this limitation when comparing the results across policies in this domain.

Unlike other domains, this domain includes two proposed policies that experts thought would increase nuclear risk: increases in low-yield nuclear weapons in the USA and in Russia. Though some experts thought these policies could decrease nuclear risk, the median expert estimated that risk would increase by 20% if Russia increased its low-yield nuclear stockpiles, and by 25% if the USA did so. In contrast, the median superforecaster didn't think that either Russia or the USA increasing their numbers of low-yield weapons would change the likelihood of nuclear catastrophe. They did, however, associate a 5% increase in risk with a policy that would cause the USA to reduce their low-yield nuclear weapons. On the other hand, both groups associated a decrease in low-yield stockpiles from Russia with the largest risk reduction, with the median expert decreasing the probability of nuclear catastrophe by 25% and the median superforecaster by 8%.

The median expert estimated a risk reduction of 22% if Russia eliminated its "launch on warning" posture, and a risk reduction of 20% if the USA did the same. The median superforecaster thought that the elimination of the "launch on warning" posture would reduce the risk of nuclear catastrophe by 6% if Russia adopted this policy, and by 3% if the USA did so. According to the median expert, a new arms control agreement similar to the INF treaty (which

expired in 2019) or New START (which expires in 2026) would reduce nuclear risk by 20%. The median superforecaster estimated a larger impact for an agreement similar to the INF treaty (9%) compared to an agreement similar to New START (5%). The median relative risk for all policies for the Russia and NATO domain are provided in Table A74.

	Expert		Superforecaster	
Policy	**N**	**Median relative risk (IQR)**	**N**	**Median relative risk (IQR)**
USA - Russia New START treaty	25	0.80x (0.75–0.91x)	11	0.95x (0.78–0.97x)
USA - Russia INF treaty	23	0.80x (0.67–0.98x)	17	0.91x (0.67–0.97x)
Russia decreases low-yield weapons	16	0.75x (0.4–0.9x)	8	0.92x (0.88–1.04x)
USA decreases low-yield weapons	16	0.94x (0.75–1x)	8	1.05x (1–1.36x)
Russia increases low-yield weapons	15	1.2x (1.01–1.04x)	9	1.00x (0.98–1.02x)
USA increases low-yield weapons	15	1.25x (1.04–1.53x)	9	1.00x (0.98–1.02x)
Russia eliminates “launch on warning”	16	0.78x (0.5–0.91x)	11	0.94x (0.88–0.99x)
USA eliminates “launch on warning”	16	0.80x (0.51–1x)	11	0.97x (0.86–1x)

Table A74: *Median relative risk for policies in the Russia and NATO domain.*

Both superforecasters and experts assessed that, of the proposed policies, the USA or Russia increasing their low-yield nuclear stockpiles was most likely to happen. The median expert forecasted a 47.5% chance for Russia to do so, and the median superforecaster forecasted a 40% probability. They both forecasted a 30% chance for the USA to increase their low-yield weapons.

Of the policies experts thought would decrease nuclear risk, both groups thought that an arms control treaty similar to New START was most likely to be implemented. The median expert assigned a 20% chance and the median superforecaster a 17.5% chance for such an agreement’s implementation, which the median expert increased to 25% with funding and the median superforecaster increased to 20.5%. Both groups believed an arms control agreement similar to the INF treaty was less likely to be reached, with the median expert and median superforecaster estimating a 5% and a 7% chance, respectively, which the median expert increased to 10% with funding. The median expert assigned a 5% probability to the implementation of a policy in which the USA eliminates its “launch on warning” posture, increasing it to 17.5% with funding. The median superforecaster thought such a policy would have a 2% chance of implementation, regardless of funding. Both groups were skeptical that Russia would implement a policy to eliminate its “launch on warning” posture. The median expert assigned a 1% probability for the policy’s implementation, and the median superforecaster thought the probability was 2%, with and without funding.

Respondents thought policies with the goal to reduce low-yield nuclear weapon stockpiles in Russia or the USA were relatively unlikely to be implemented. The median expert thought the probability for Russia to adopt such a policy was 3%, and 5% for the USA. The median superforecaster estimated a 0.55% chance for Russia to decrease their low-yield weapons, and a 3.5% for the USA to do so.

In general, both groups thought that funding would have less impact on the probability of implementation for policies in Russia compared to policies in the USA. Table A75 shows the probabilities that the policies in the Russia and NATO domain will be implemented, and the median funding multipliers.

	Experts				**Superforecasters**			
Policy	N	Prob. implementation	Prob. with funding	Median funding multiplier	N	Prob. implementation	Prob. with funding	Median funding multiplier
USA - Russia New START treaty	26	20%	25%	1.2x	17	17.5%	20.5%	1.07x
USA - Russia INF treaty	23	5%	10%	1.25x	12	7%	6%	1.03x
Russia decreases low-yield weapons	28	3%	3%	1.15x	7	0.55%	0.6%	1x
USA decreases low-yield weapons	28	5%	7%	1.5x	7	3.5%	4.25%	1.1x
Russia increases low-yield weapons	16	47.5%	50%	1.0x	11	40%	41%	1.03x
USA increases low-yield weapons	15	30%	47.5%	1.2x	11	30%	40%	1.1x
Russia eliminates “launch on warning”	13	1%	2.5%	1x	9	2%	2%	1.0x
USA eliminates “launch on warning”	13	5%	17.5%	1.75x	9	2%	2%	1.1x

Table A75: *Median forecasts for each policy to get implemented, unconditional and conditional on the policy receiving additional funding, and median funding multipliers.*

In terms of ranking, a policy for an arms control agreement succeeding New START was the most popular among all participants, ranking 3.5 on average among experts for implementation and 3.5 for funding. The average rank for implementation of this policy among superforecasters was 3.9, and 4.8 for receiving additional funding. A new treaty similar to the INF also received relatively high ranks in both groups; for implementation, experts ranked this policy 5.2 on

average and superforecasters ranked it 4.0 on average. For funding, the average rank was 6.0 among experts and 4.8 among superforecasters. Among experts, a policy for Russia to decrease its low-yield nuclear stockpiles received an average rank of 4.8, but had an average rank of 7.0 for funding. The average expert ranks for a policy to eliminate Russia's "launch on warning" posture are similar, with 4.9 for implementation and 7.2 for funding, reflecting how low experts estimated the impact of funding on these policies' chances of implementation. The average rank for the USA to eliminate its "launch on warning" posture was 5.9 among experts and 6.5 among superforecasters, ranking 5.5 on average with funding among experts and 7.2 among superforecasters. The expert group ranked a policy for the USA to decrease its low-yield nuclear stockpiles 6.3 for implementation and 6.5 with funding on average, while the superforecaster group ranked it 8.4 for implementation and 7.9 with funding on average. Experts ranked policies to increase low-yield nuclear weapons in Russia or the USA lowest on average, with 7.5 for the USA and 8.5 for Russia. Superforecasters ranked the implementation of this policy 6.9 in the USA and 7.8 in Russia.

A15. Appendix 15: Detailed policy results

Relative risk

	Expert				Superforecaster			
Policy	**N**	**Median**	**25th%**	**75th%**	**N**	**Median**	**25th%**	**75th%**
General								
CTBT is ratified	95	0.90	0.67	1.00	37	0.95	0.80	1.00
Failsafe reviews	96	0.80	0.61	0.94	37	0.90	0.75	0.98
Crisis communications network	96	0.75	0.49	0.90	37	0.85	0.71	0.95
FMCT is signed	95	0.91	0.78	1.00	37	0.97	0.89	1.00
USA removes 'sole authority'	96	0.90	0.75	1.00	37	0.97	0.83	1.00
AI risk assessment	94	0.80	0.60	0.96	37	0.93	0.83	0.98
All six policies	96	0.50	0.20	0.69	37	0.58	0.25	0.76
China and the USA								
USA implements 'no-first-use'	9	1.00	0.90	1.00	4	0.90	0.78	1.02
USA - China missile launch notification agreement	9	0.80	0.75	0.84	4	0.93	0.89	0.95
USA - China regular dialogue	9	0.75	0.50	0.80	4	0.88	0.84	0.89
Korean Peninsula								
USA - NK track 1.5 dialogue	15	0.80	0.70	0.98	4	0.95	0.88	1.00
USA declares no left-of-launch attacks on NK	15	0.90	0.75	1.00	4	1.00	1.00	1.02
USA establishes liaison office in Pyongyang	15	0.90	0.78	0.99	4	0.93	0.83	1.00

	Expert				Superforecaster			
Policy	**N**	**Median**	**25th%**	**75th%**	**N**	**Median**	**25th%**	**75th%**
India and Pakistan								
India - Pakistan formalize low-alert status	23	0.70	0.51	0.92	1	0.95	0.95	0.95
India - Pakistan information exchange	23	0.80	0.56	1.00	1	0.98	0.98	0.98
India - Pakistan NNRC	24	0.68	0.49	0.90	1	0.98	0.98	0.98
Russia and NATO								
USA eliminates LoW	16	0.80	0.52	1.00	11	0.97	0.86	1.00
Russia eliminates LoW	16	0.78	0.50	0.91	11	0.94	0.88	1.00
Russia decreases low-yield weapons	16	0.75	0.40	0.90	8	0.92	0.88	1.04
USA decreases low-yield weapons	16	0.94	0.75	1.00	8	1.05	1.00	1.36
Russia increases low-yield weapons	15	1.20	1.01	1.40	9	1.00	0.98	1.02
USA increases low-yield weapons	15	1.25	1.04	1.53	9	1.00	0.98	1.03
USA - Russia New START treaty	25	0.80	0.75	0.91	11	0.95	0.78	0.97
USA - Russia INF treaty	23	0.80	0.67	0.98	17	0.91	0.67	0.97

Table A76: *Summary of participant views on relative change in probability of nuclear catastrophe, conditional on policies being implemented.*

Proportion who report policy will decrease, increase, or not affect risk

	Expert				Superforecaster			
Policy	N	Decrease risk	Not affect risk	Increase risk	N	Decrease risk	Not affect risk	Increase risk
General								
CTBT is ratified	95	61%	39%	0%	37	68%	32%	0%
Failsafe reviews	96	78%	22%	0%	37	95%	5%	0%
Crisis communications network	96	89%	11%	0%	37	95%	5%	0%
FMCT is signed	95	58%	42%	0%	37	65%	35%	0%
USA removes 'sole authority'	96	64%	28%	8%	37	62%	27%	11%
AI risk assessment	94	78%	22%	0%	37	86%	14%	0%
All six general policies	96	93%	4%	3%	37	100%	0%	0%
China and the USA								
USA implements 'no-first-use'	9	44%	56%	0%	4	50%	25%	25%

	Expert				Superforecaster			
Policy	N	Decrease risk	Not affect risk	Increase risk	N	Decrease risk	Not affect risk	Increase risk
USA - China missile launch notification agreement	9	100%	0%	0%	4	100%	0%	0%
USA - China regular dialogue	9	100%	0%	0%	4	100%	0%	0%
Korean Peninsula								
USA - NK track 1.5 dialogue	15	73%	27%	0%	4	50%	50%	0%
USA declares no left-of-launch attacks on NK	15	60%	33%	7%	4	25%	50%	25%
USA establishes liaison office in Pyongyang	15	73%	27%	0%	4	50%	50%	0%
India and Pakistan								
India - Pakistan formalize low-alert status	23	78%	17%	4%	1	100%	0%	0%
India - Pakistan information exchange	23	65%	35%	0%	1	100%	0%	0%
India - Pakistan NNRC	24	79%	21%	0%	1	100%	0%	0%
Russia and NATO								
USA eliminates LoW	16	69%	19%	13%	11	64%	36%	0%
Russia eliminates LoW	16	81%	13%	6%	11	73%	27%	0%
Russia decreases low-yield weapons	16	88%	13%	0%	8	63%	13%	25%
USA decreases low-yield weapons	16	63%	25%	13%	8	13%	38%	50%
Russia increases low-yield weapons	15	0%	27%	73%	9	33%	33%	33%
USA increases low-yield weapons	15	13%	13%	73%	9	33%	33%	33%
USA - Russia New START treaty	25	80%	20%	0%	11	82%	18%	0%
USA - Russia INF treaty	23	78%	13%	9%	17	82%	12%	6%

Table A77: *Proportion of participants who believe policies would decrease, not affect, or increase the probability of nuclear catastrophe.*

Absolute risk reduction

	Expert				Superforecaster			
Policy	**N**	**Median**	**25th%**	**75th%**	**N**	**Median**	**25th%**	**75th%**
General								
CTBT is ratified	97	-0.05pp	-3pp	0pp	37	-0.01pp	-0.254pp	0pp
Failsafe reviews	98	-0.5pp	-2pp	0pp	37	-0.099pp	-0.4pp	-0.01pp

	Expert				Superforecaster			
Policy	**N**	**Median**	**25th%**	**75th%**	**N**	**Median**	**25th%**	**75th%**
Crisis communications network	98	-0.85pp	-4.375pp	-0.023pp	37	-0.1pp	-0.65pp	-0.02pp
FMCT is signed	97	-0.01pp	-2pp	0pp	37	-0.01pp	-0.1pp	0pp
USA removes 'sole authority'	98	-0.1pp	-1pp	0pp	37	-0.02pp	-0.127pp	0pp
AI risk assessment	96	-0.5pp	-3pp	0pp	37	-0.04pp	-0.2pp	-0.004pp
China and the USA								
USA implements 'no-first-use'	9	0pp	-2pp	0pp	4	-0.15pp	-0.3pp	0.02pp
USA - China missile launch notification agreement	9	-2pp	-5pp	-1pp	4	-0.175pp	-0.438pp	-0.08pp
USA - China regular dialogue	9	-3pp	-5pp	-2pp	4	-0.225pp	-0.688pp	-0.175pp
Korean Peninsula								
USA - NK track 1.5 dialogue	15	-0.2pp	-2pp	0pp	4	-0.025pp	-0.288pp	0pp
USA declares no left-of-launch attacks on NK	15	0pp	-0.75pp	0pp	4	0pp	0pp	0.05pp
USA establishes liaison office in Pyongyang	15	-0.1pp	-2pp	0pp	4	-0.035pp	-0.402pp	0pp
India and Pakistan								
India - Pakistan formalize low-alert status	24	-0.95pp	-16.25pp	0pp	1	-0.001pp	-0.001pp	-0.001pp
India - Pakistan information exchange	24	-0.053pp	-4.375pp	0pp	1	0pp	0pp	0pp
India - Pakistan NNRC	25	-2pp	-10pp	0pp	1	0pp	0pp	0pp
Russia and NATO								
USA eliminates LoW	16	-0.35pp	-2pp	0pp	11	-0.002pp	-0.068pp	0pp
Russia eliminates LoW	16	-0.4pp	-2pp	-0.061pp	11	-0.02pp	-0.185pp	0pp
Russia decreases low-yield weapons	17	-0.5pp	-1pp	-0.04pp	8	-0.016pp	-0.25pp	0.037pp
USA decreases low-yield weapons	17	-0.03pp	-0.5pp	0pp	8	0.005pp	0pp	0.337pp
Russia increases low-yield weapons	15	1pp	0.005pp	6.25pp	9	0pp	-0.05pp	0.02pp
USA increases low-yield weapons	15	2pp	0.01pp	5pp	9	0pp	-0.05pp	0.04pp
USA - Russia New START treaty	26	-0.75pp	-2.75pp	-0.032pp	11	-0.04pp	-0.473pp	-0.002pp
USA - Russia INF treaty	23	-0.5pp	-3.5pp	-0.002pp	17	-0.1pp	-0.15pp	-0.03pp

Table A78: *Summary of participant views on absolute change in probability of nuclear catastrophe, conditional on policies being implemented.*

Unconditional probability of policy implementation

	Expert				Superforecaster			
Policy	**N**	**Median**	**25th%**	**75th%**	**N**	**Median**	**25th%**	**75th%**
General								
CTBT is ratified	106	6.5%	1%	15%	39	5%	1%	9.5%
Failsafe reviews	105	15%	10%	30%	39	7%	3.5%	16%
Crisis communications network	106	15%	5%	30%	39	10%	4%	25%
FMCT is signed	106	5%	1%	10%	39	5%	1%	13.5%
USA removes 'sole authority'	107	10%	3%	20%	39	4%	0.5%	10%
AI risk assessment	106	20%	10%	40%	39	9%	3%	21.5%
China and the USA								
USA implements 'no-first-use'	10	7.5%	5%	17.5%	4	1%	0%	9.5%
USA - China missile launch notification agreement	10	27.5%	20%	40%	4	32%	3.5%	61.25%
USA - China regular dialogue	10	45%	32.5%	65%	4	13%	4.75%	28.75%
Korean Peninsula								
USA - NK track 1.5 dialogue	16	12.5%	4.25%	35%	4	4%	3%	6.25%
USA declares no left-of-launch attacks on NK	16	5%	4%	15%	4	2%	1.75%	19%
USA establishes liaison office in Pyongyang	16	10%	2.5%	26.25%	4	5%	2%	21%
India and Pakistan								
India - Pakistan formalize low-alert status	28	10%	2.775%	18.5%	1	4%	4%	4%
India - Pakistan information exchange	28	10%	6.5%	21.25%	1	4%	4%	4%
India - Pakistan NNRC	28	15%	6.5%	20%	1	4%	4%	4%
Russia and NATO								
USA eliminates LoW	16	5%	1%	12.5%	11	2%	0.55%	3.5%
Russia eliminates LoW	16	1%	0.775%	6.25%	11	2%	0.55%	3.5%
Russia decreases low-yield weapons	21	3%	0.5%	10%	8	0.55%	0.088%	3.75%

	Expert				Superforecaster			
Policy	**N**	**Median**	**25th%**	**75th%**	**N**	**Median**	**25th%**	**75th%**
USA decreases low-yield weapons	21	5%	1%	10%	8	3.5%	0.088%	12.5%
Russia increases low-yield weapons	16	47.5%	30%	70%	11	40%	10%	67.5%
USA increases low-yield weapons	16	30%	15%	52.5%	11	30%	11%	41%
USA - Russia New START treaty	27	20%	8.5%	35%	12	17.5%	9.25%	30%
USA - Russia INF treaty	26	5%	2%	15%	18	7%	2.75%	21%

Table A79: *Summary of participant unconditional forecasts of policy implementation. Participants were asked to forecast the probability that the policy would be implemented, under a time frame that assumes a decision is made within the next three years to implement the policy. (We use this approach as different policies would likely take different amounts of time to implemented).*

Probability of policy implementation with funding

	Expert				Superforecaster			
Policy	**N**	**Median**	**25th%**	**75th%**	**N**	**Median**	**25th%**	**75th%**
General								
CTBT is ratified	106	10%	2.625%	28.75%	39	7%	2%	10%
Failsafe reviews	105	30%	15%	50%	39	10%	5.095%	23%
Crisis communications network	106	25%	10%	50%	39	18%	6%	36.5%
FMCT is signed	106	6.5%	2%	15.75%	39	9%	2%	15%
USA removes 'sole authority'	107	20%	6%	35%	39	5%	1%	16.5%
AI risk assessment	106	30%	10%	53.75%	39	12%	4%	31.5%
China and the USA								
USA implements 'no-first-use'	10	15%	10%	27.5%	4	1.5%	0.75%	10.25%
USA - China missile launch notification agreement	10	50%	28.75%	50%	4	34.5%	3.75%	66.25%
USA - China regular dialogue	10	55%	42.5%	73.75%	4	15%	5%	31.75%
Korean Peninsula								
USA - NK track 1.5 dialogue	16	20%	8%	61.25%	4	6.505%	2.757%	10%
USA declares no left-of-launch attacks on NK	16	12.5%	4%	20%	4	3.505%	1.757%	25%

	Expert				Superforecaster			
Policy	**N**	**Median**	**25th%**	**75th%**	**N**	**Median**	**25th%**	**75th%**
USA establishes liaison office in Pyongyang	16	15%	8%	29.75%	4	7%	4%	22%
India and Pakistan								
India - Pakistan formalize low-alert status	28	13.5%	4.5%	20%	1	4%	4%	4%
India - Pakistan information exchange	28	17.5%	8.75%	31.25%	1	4%	4%	4%
India - Pakistan NNRC	28	20%	8.75%	35%	1	4%	4%	4%
Russia and NATO								
USA eliminates LoW	16	17.5%	4.5%	23.75%	11	2%	0.3%	4.75%
Russia eliminates LoW	16	2.5%	1%	10%	11	2%	0.05%	4%
Russia decreases low-yield weapons	21	3%	0.6%	10%	8	0.6%	0.09%	4.5%
USA decreases low-yield weapons	21	7%	2%	15%	8	4.25%	0.09%	13%
Russia increases low-yield weapons	16	50%	30%	72.5%	11	41%	10.5%	72.5%
USA increases low-yield weapons	16	47.5%	26.25%	62.5%	11	40%	11.1%	57.5%
USA - Russia New START treaty	27	25%	15%	50%	12	20.5%	9.25%	32%
USA - Russia INF treaty	26	10%	5%	18.75%	18	6%	1.275%	22.5%

Table A80: *Summary of participant forecasts of policy implementation conditional on a nonprofit team with the goal of getting the policy implemented receiving $500 million of funding. Participants were asked to forecast the probability that the policy would be implemented, under a time frame that assumes a decision is made within the next three years to implement the policy. (We use this approach as different policies would likely take different amounts of time to implemented).*

Funding multiplier

	Experts				Superforecasters			
Policy	**N**	**Median**	**25th%**	**75th%**	**N**	**Median**	**25th%**	**75th%**
General								
CTBT is ratified	97	1.3	1.0	2.0	36	1.1	1.0	1.4
Failsafe reviews	103	1.5	1.2	2.0	38	1.4	1.1	2.0
Crisis communications network	104	1.4	1.1	1.8	39	1.3	1.1	2.0
FMCT is signed	97	1.2	1.0	1.8	38	1.1	1.0	1.5
USA removes 'sole authority'	98	1.5	1.2	2.0	35	1.3	1.0	1.9
AI risk assessment	102	1.5	1.1	1.9	39	1.3	1.1	1.5

	Experts				Superforecasters			
Policy	N	Median	25th%	75th%	N	Median	25th%	75th%
China and the USA								
USA implements 'no-first-use'	10	1.5	1.1	2.7	2	1.0	1.0	1.1
USA - China missile launch notification agreement	10	1.3	1.0	1.6	4	1.1	1.0	1.3
USA - China regular dialogue	10	1.2	1.0	1.3	4	1.1	1.0	1.4
Korean Peninsula								
USA - NK track 1.5 dialogue	16	1.3	1.1	1.5	4	1.0	0.9	1.3
USA declares no left-of-launch attacks on NK	15	1.3	1.0	1.8	4	1.1	0.9	2.2
USA establishes liaison office in Pyongyang	16	1.4	1.1	1.6	4	1.1	0.9	1.5
India and Pakistan								
India - Pakistan formalize low-alert status	27	1.0	1.0	1.7	1	1.0	1.0	1.0
India - Pakistan information exchange	27	1.1	1.0	1.5	1	1.0	1.0	1.0
India - Pakistan NNRC	27	1.3	1.0	1.6	1	1.0	1.0	1.0
Russia and NATO								
Russia eliminates LoW	13	1.8	1.5	2.0	9	1.0	1.0	1.2
USA eliminates LoW	13	1.0	1.0	1.5	9	1.1	1.0	1.5
Russia decreases low-yield weapons	18	1.2	1.0	1.9	7	1.0	1.0	1.3
USA decreases low-yield weapons	18	1.5	1.0	1.9	7	1.1	1.0	1.2
Russia increases low-yield weapons	16	1.0	1.0	1.1	11	1.0	1.0	1.2
USA increases low-yield weapons	15	1.2	1.0	1.5	11	1.1	1.0	1.5
USA - Russia New START treaty	26	1.2	1.0	1.5	12	1.1	1.0	1.4
USA - Russia INF treaty	23	1.3	1.0	2.0	17	1.0	1.0	1.2

Table A81: *Summary of participants' views on the impact made by funding on the probability of policy implementation. This is calculated by dividing the probability of implementation with funding by the unconditional probability of implementation.*

Ranking of policies for implementation

	Expert				Superforecaster			
Policy	**N**	**Mean**	**SD**	**Prop. ranking in top 3**	**N**	**Mean**	**SD**	**Prop. ranking in top 3**
General								
CTBT is ratified	109	4.35	2.51	41%	39	4.74	2.12	33%
Failsafe reviews	109	3.83	2.05	50%	39	3.69	2.00	51%
Crisis communications network	109	3.26	2.03	58%	39	3.03	2.06	62%
FMCT is signed	109	5.20	2.45	28%	39	4.90	2.21	31%
USA removes 'sole authority'	109	6.65	2.25	13%	39	6.03	2.76	28%
AI risk assessment	109	4.61	2.36	39%	39	4.72	2.62	33%
China and the USA								
USA implements 'no-first-use'	10	6.90	3.00	20%	4	6.25	3.59	25%
USA - China missile launch notification agreement	10	3.70	2.26	60%	4	5.75	0.50	0%
USA - China regular dialogue	10	3.40	2.37	50%	4	3.75	2.36	50%
Korean Peninsula								
USA - NK track 1.5 dialogue	16	5.31	2.65	25%	4	6.75	1.26	0%
USA declares no left-of-launch attacks on NK	16	6.81	2.34	19%	4	7.25	2.36	0%
USA establishes liaison office in Pyongyang	16	6.13	2.31	13%	4	6.00	1.63	0%
India and Pakistan								
India - Pakistan formalize low-alert status	29	5.62	2.27	17%	1	5.00	NA	0%
India - Pakistan information exchange	29	6.66	1.84	7%	1	8.00	NA	0%
India - Pakistan NNRC	29	5.72	2.05	14%	1	9.00	NA	0%
Russia and NATO								
USA eliminates LoW	17	5.94	2.90	24%	11	6.46	1.70	9%
Russia eliminates LoW	17	5.12	2.71	41%	11	6.55	2.02	9%
Russia decreases low-yield weapons	21	4.81	2.77	43%	8	5.38	3.20	38%
USA decreases low-yield weapons	21	6.33	2.15	5%	8	8.38	0.74	0%

	Expert				Superforecaster			
Policy	**N**	**Mean**	**SD**	**Prop. ranking in top 3**	**N**	**Mean**	**SD**	**Prop. ranking in top 3**
Russia increases low-yield weapons	16	8.50	0.82	0%	11	7.82	1.72	0%
USA increases low-yield weapons	16	7.50	1.79	6%	11	6.82	1.72	9%
USA - Russia New START treaty	28	3.50	2.12	57%	12	3.92	2.50	42%
USA - Russia INF treaty	26	5.19	2.53	27%	18	4.00	2.68	56%

Table A82: *Summary of participant responses to ranking exercise that asked for participants to rank the policies by how much they would like them to be implemented. The mean rank standard deviation, and proportion of respondents who ranked the policy within the top three of nine are shown.*

Ranking of policies for funding

	Expert				Superforecaster			
Policy	**N**	**Mean**	**SD**	**Prop. ranking in top 3**	**N**	**Mean**	**SD**	**Prop. ranking in top 3**
General								
CTBT is ratified	109	4.69	2.26	28%	39	4.82	1.73	26%
Failsafe reviews	109	3.48	1.92	61%	39	3.26	1.77	62%
Crisis communications network	109	2.92	1.81	70%	39	2.41	1.65	77%
FMCT is signed	109	5.69	2.24	17%	39	4.95	2.01	18%
USA removes 'sole authority'	109	6.34	2.28	11%	39	6.36	2.40	18%
AI risk assessment	109	3.61	2.20	52%	39	3.92	2.33	46%
China and the USA								
USA implements 'no-first-use'	10	7.50	2.17	10%	4	7.75	0.96	0%
USA - China missile launch notification agreement	10	4.50	2.92	50%	4	5.75	1.50	0%
USA - China regular dialogue	10	4.00	2.98	50%	4	4.50	3.70	50%
Korean Peninsula								
USA - NK track 1.5 dialogue	16	4.13	2.28	56%	4	4.50	1.92	50%
USA declares no left-of-launch attacks on NK	16	7.44	2.31	13%	4	6.50	2.89	0%

	Expert				Superforecaster			
Policy	**N**	**Mean**	**SD**	**Prop. ranking in top 3**	**N**	**Mean**	**SD**	**Prop. ranking in top 3**
USA establishes liaison office in Pyongyang	16	6.13	2.28	13%	4	6.25	3.59	25%
India and Pakistan								
India - Pakistan formalize low-alert status	29	6.35	1.97	10%	1	9.00	NA	0%
India - Pakistan information exchange	29	6.72	2.09	10%	1	4.00	NA	0%
India - Pakistan NNRC	29	5.59	2.32	21%	1	5.00	NA	0%
Russia and NATO								
USA eliminates LoW	17	5.47	2.76	35%	11	7.18	1.33	0%
Russia eliminates LoW	17	7.24	2.25	12%	11	7.73	1.68	9%
Russia decreases low-yield weapons	21	7.05	1.77	5%	8	7.88	0.99	0%
USA decreases low-yield weapons	21	6.52	1.86	5%	8	7.88	0.84	0%
Russia increases low-yield weapons	16	8.63	0.72	0%	11	8.18	0.75	0%
USA increases low-yield weapons	16	7.25	1.53	6%	11	6.91	1.76	9%
USA - Russia New START treaty	28	3.54	2.40	57%	12	4.17	3.13	58%
USA - Russia INF treaty	26	5.96	2.11	15%	18	4.83	2.48	39%

Table A83: *Summary of participant responses to ranking exercise that asked for participants to rank the policies by how much they would like to see $500 million in funding go to a hypothetical nonprofit team with the goal of getting the policy implemented. The mean rank standard deviation, and proportion of respondents who ranked the policy within the top three of nine are shown.*

A16. Appendix 16: Policy suggestions from participants

At the end of Survey 2, we asked participants which other policies they would have liked to have seen in the survey. We received 168 suggestions from 105 participants and categorized them into 16 topics. Below are the topics and summaries of the suggestions.

- **Arms control and disarmament:** Most commonly mentioned were policies relating to arms control and disarmament. We received 25 suggestions for policies to reduce or restrict nuclear arsenals; 16 responses mentioning policies to ban all nuclear weapons, specific weapon types or delivery systems, of which five specifically mention the Treaty on the Prohibition of Nuclear Weapons (TPNW); three responses asking for policies

about unilateral disarmament; and five responses relating to other aspects of nuclear disarmament. Details of the suggestions are summarized below.
    - Multilateral arms control agreements on warheads, delivery systems, or defense systems (such as Anti-satellite and missile defenses). A trilateral agreement between Russia, China and the USA and agreements modeled after New START were mentioned multiple times.
    - Reducing nuclear weapons stockpiles or introducing a hard cap on warhead numbers.
    - The USA shifts away from the nuclear triad.
    - A ban on all nuclear weapons.
    - Banning certain types of nuclear weapons, such as non-strategic nuclear weapons, weapons that can't be recalled, or multiple warhead ICBMs.
    - Banning certain types of delivery systems, such as land- or air-based systems or dual-capable cruise missiles.
    - Expanding the TPNW, possibly to all nuclear states.
    - Nuclear states attend TPNW meetings as observers.
    - The unilateral reduction or elimination of nuclear arsenals, for example by the USA.
    - Research on how disarmament relates to nuclear risk reduction.
    - Policies that support civil initiatives to promote nuclear disarmament.
    - Reduce spending on nuclear weapons.
- **Nuclear Weapons Free Zones (NWFZ):** Three participants suggested policies for nuclear-weapon-free zones (NFWZ), or to assess the impact of NFWZs on nuclear risk.
- **Nuclear doctrine:** 15 of the responses mentioned policies related to changes in the nuclear doctrine of nuclear-armed states, of which 11 related to no-first-use (NFU) policies.
    - A first use treaty between P5 states[377] and India and Pakistan.
    - Nuclear states renounce first use.
    - Russia or NATO adopt an NFU policy.
    - China removes its NFU policy.
    - A bilateral NFU treaty between India and Pakistan.
    - A policy for all or any nuclear state to adopt a "sole purpose" doctrine.
- **General military doctrine:** Three responses revolved around military doctrine in general. Proposals include the reduction of nuclear weapons in military doctrines, to reduce the reliance on non-strategic nuclear weapons in military planning and exercises, and to review the role of advanced conventional weapons on nuclear strategy.
- **Non-proliferation:** Another 15 policy suggestions related to non-proliferation, of which eight were about the Treaty on the Non-Proliferation of Nuclear Weapons (NPT).
    - Expand the NPT to other states, such as Pakistan, India, Israel and North Korea.
    - Reform or renegotiate the NPT.
    - Nuclear-armed states reaffirm and implement their disarmament commitments under the NPT.

[377] China, France, Russia, the UK, the USA.

    - Discourage non-nuclear states such as Iran and Saudi Arabia from obtaining nuclear weapons, for example by sanctions and other economic actions.
    - International agreements to inhibit technology transfers that enable the acquisition of nuclear weapons.
    - An anti-proliferation treaty between P5 states, Pakistan and India.
    - Proliferation of nuclear weapons to allies of the USA, such as South Korea and Japan.
- **Verification:** Three responses suggested policies to improve means of verification. This includes training of personnel and the improvement of and investment into technical tools, such as in situ recovery capabilities and the platforms national technical means of verification are based on.
- **Inter-state relations and communication:** 15 responses included policies on improving inter-state relations.
    - New confidence building measures, for example between India and Pakistan, or mutual site visits among nuclear states.
    - Dialogues on nuclear or other strategic issues between India and Pakistan or between the USA and China and Russia.
    - Arms control talks between the USA and China or Russia.
    - Have nuclear states coordinate on nuclear retaliation, for example in response to nuclear weapons from space.
    - Analyze the cooperation between Russia, China, North Korea and Iran and their influence on nuclear risk.
    - Ban threats of nuclear weapons use.
    - Increase spending on diplomacy efforts.
    - Educate leaders on adversaries' cultures, including their histories, national views and paranoias.
    - Investigate the role of backchannels in crisis management.
- **Deterrence agreements:** Deterrence agreements were subject of eight policy suggestions.
    - Extend nuclear deterrence agreements, for example between Russia and other states, or expand the NATO nuclear umbrella to include all of Europe and Turkey.
    - Improve policies on nuclear sharing.
    - A NATO policy on nuclear sharing that involves Russia's alleged deployment of nuclear weapons in Belarus.
    - Reducing the reliance of other NATO states on the USA by improving their defense spending, by the USA withdrawing its nuclear weapons from these countries, or by the USA declaring an "America First" isolationist policy.
    - Increase the understanding of hub-and-spoke deterrence and gaps in deterrence and assurances.
- **North Korea and the USA:** Five responses suggested policies specific to the "North Korea and the USA" domain:
    - The USA refrains from joint military exercises with South Korea.
    - Denuclearization talks with North Korea.

    - The USA declares it will conduct left of launch attacks on North Korean NC3 systems.
    - The USA declares it will review the relocation of tactical nuclear weapons to the Korean Peninsula if North Korea continuously threatens the USA or South Korea with nuclear weapons.
    - The USA pursues an arms control agreement with North Korea instead of pursuing the total dismantling of the North Korean nuclear program.
- **Cyberdefense and AI:** Four responses point to cybersecurity and to the risk of using AI systems in decision making processes related to nuclear weapons. They mention cyberthreats to nuclear command and control systems and how machine learning algorithms could be used to filter which information is presented to humans.
- **Space:** Another four responses related to the use of space for nuclear purposes. The policy suggestions included restrictions on the testing of anti-satellite weapons (ASAT), for example by a moratorium, limits on targeting space-based NC3 assets such as early warning satellites, and increasing investments into open-source satellite imagery.
- **Public education:** Five participants would have liked to see a policy aimed at informing the public about the dangers of nuclear weapons, such as their destructive potential and the risk of nuclear winter. They suggest running information campaigns or having relatable spokespeople address these issues across traditional and social media. One person suggested a global network engaging civil societies, decision-makers, academia and policy communities across all states with nuclear weapons, with nuclear energy and fuel cycle programs, and states under the nuclear umbrella. The goal of these information campaigns would be the stigmatization of nuclear weapons, avoiding the normalization of (low-yield) nuclear weapons, and reinforcing the perception of nuclear weapons as dangerous rather than beneficial for security.
- **Non-nuclear weapons:** Four responses asked for policies to address issues related to conventional weapons. They mention that the deterioration of conventional arms control agreements influence discussions on nuclear weapons and new concerns regarding conventional capabilities such as laser blending weapons and lethal autonomous weapons systems. Suggested policies in this category are a multilateral agreement to restrain the use of non-nuclear weapons that threaten retaliatory capabilities, and for the USA and Russia to reassume conventional arms control.
- **Non-nuclear states:** Five responses asked to include policies that included non-nuclear states such as the non-nuclear EU, allies to nuclear states and the Global South. Non-nuclear states could contribute to reducing nuclear risk by taking part in decision-making processes or taking over negotiating roles.
- **Adapt policies:** Four participants suggested changing the policy recommendations that we had included for the FM(C)T treaty, the CTBT ratification, nuclear risk reduction centers and failsafe reviews so that they included more states (each of the four policies was mentioned once).
- **Other:** Some responses didn't fit into any of the above categories and are summarized below.
    - Sanctions for treaty violations.
    - Growth of the USA's nuclear stockpile in size, quality or options.

- A no-first-test commitment.
- A non-attack agreement on NC2 infrastructure.
- Addressing Russian anti-west policies and attitudes.
- Nuclear waste management and nuclear forensics.
- For the International Criminal Court to declare nuclear detonations in warfare a crime against humanity.
- Strengthen the IAEA with more funding and resources.
- Multilateral monitoring of launch readiness.
- Implement missile defense systems such as THAAD.
- Reevaluate and potentially revisit the Strategic Defense Initiative.
- Address territorial disputes and geopolitical concerns, especially in the Middle East.
- US funding for Israel based on the country possessing nuclear weapons.
- Potential new nuclear weapons (miniaturization).
- Changes in how states understand security systems.
- Revitalize the “P5 Process” to include AI, C3, risk reduction and failsafe review.
- Disentangle nuclear and conventional weapons.
- Research the dynamics of arms racing and escalation, for example between Pakistan, India and China.
- Conduct a Nuclear Risk Reduction Summit similar to the Nuclear Security Summit.
- Reduce the risk of non-state actors acquiring nuclear weapons, for example by agreements on the safeguarding of fissile material.
- Disband NATO.
- De-altering.
- Include a clause in policies putting Iran, Israel and North Korea in the loop to ensure policy compliance and implementation.
- Increasing transparency with China.

A17. Appendix 17: Additional results for “Factors influencing forecasts”

Demographics and expertise

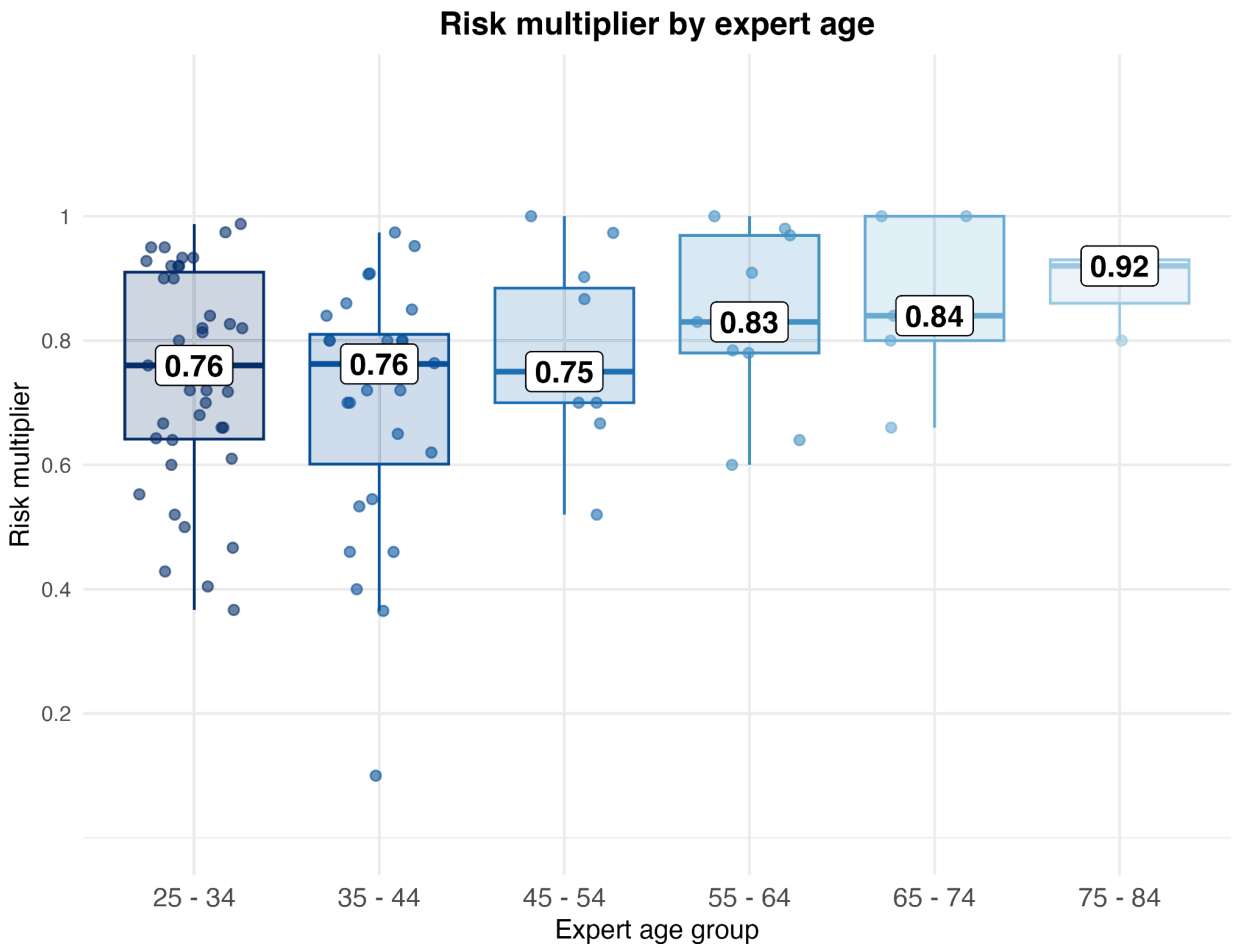

Figure A9: *Average relative risk for five general policies (minus Sole Authority) by age group (experts only). We jitter the data points horizontally to allow for better visualization of the distribution of forecasts. Horizontal variation within each group serves no other empirical purpose. The median forecast is provided in text. The boxes show the 25th–75th percentile forecasts, and the lines the range of forecasts minus outliers. We jitter the data points horizontally to allow for better visualization of the distribution of forecasts. Horizontal variation within each group serves no other empirical purpose.*

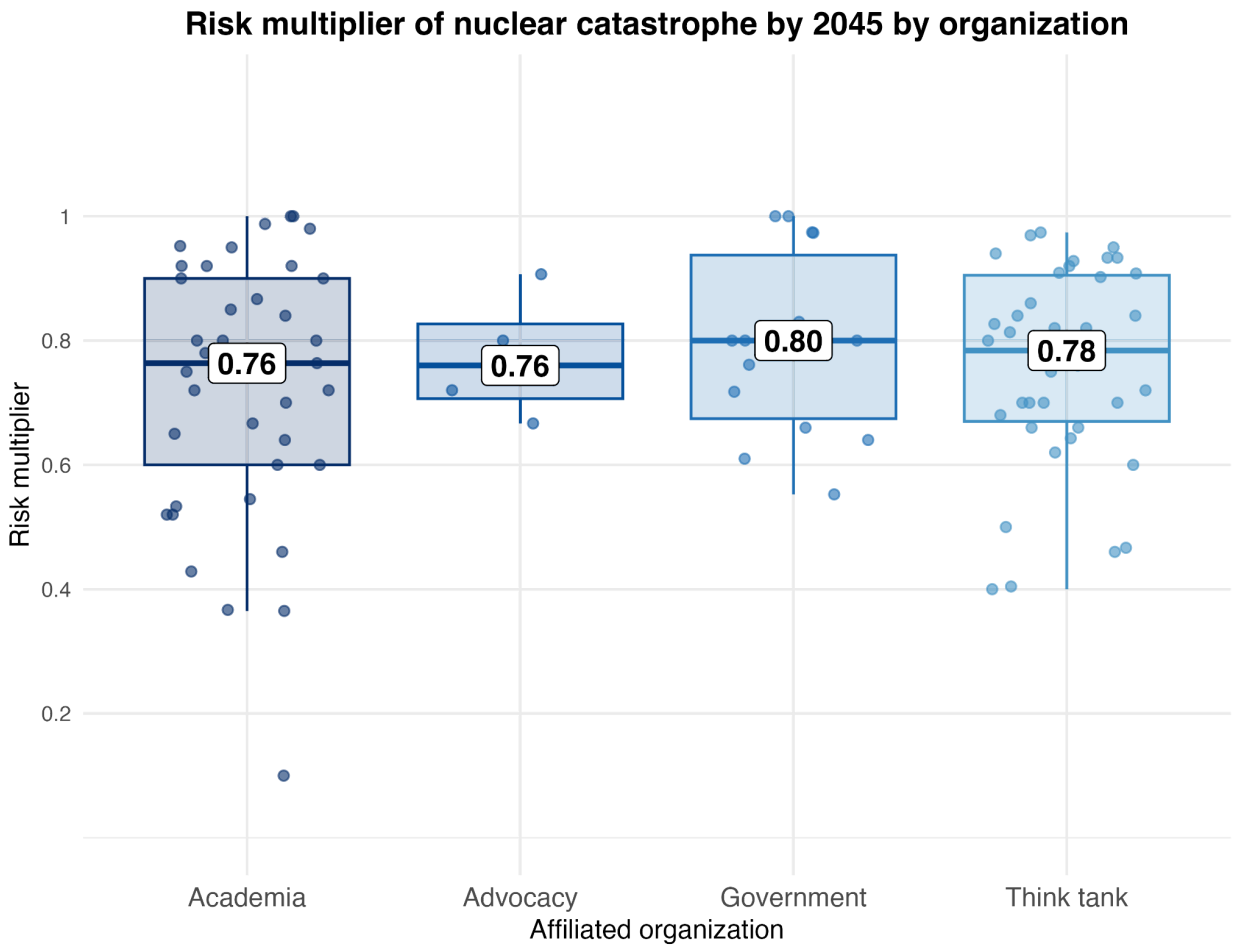

Figure 37: Average relative risk for five general policies (minus Sole Authority) disaggregated by type of affiliated organization (experts only). The median forecast is provided in text. The boxes show the 25th–75th percentile forecasts, and the lines the range of forecasts minus outliers. We jitter the data points horizontally to allow for better visualization of the distribution of forecasts. Horizontal variation within each group serves no other empirical purpose.

Beliefs about contentious issues

Statement selected as closest match to views[378]	Experts		Superforecasters	
	Median forecast of nuclear catastrophe	p-value *	Median forecast of nuclear catastrophe	p-value*
Deterrence				
Deterrence is inherently fragile	3%	0.36	1.02%	0.81
Deterrence is robust	2%		1.3%	
Escalation				
Nuclear escalation is very likely	5.5%	0.12	1%	0.47
Nuclear escalation can be prevented	3%		3%	
Disarmament				
We should push for total disarmament now	5.5%	0.27	1%	0.26
Total disarmament should not be an ultimate goal	4%		1.65%	
Nuclear energy				
We should not deter non-nuclear states from developing nuclear energy	5%	0.36	1.04%	0.21
We shouldn't support nuclear energy in states without nuclear weapons	10%		0.7%	

Table A84: *Median forecasts on the probability of catastrophe disaggregated by deterrence and escalation beliefs. *p-value derived from Mann-Whitney U test, evaluating for difference in the distribution of forecasts between respondents choosing each statement, within expert and superforecaster groups.*

[378] Summaries of the full statements are presented here. We suggest reading the full statements, which can be found in Appendix 4.

Statement selected as closest match to views[379]	Experts		Superforecasters	
	Median forecast of nuclear catastrophe	p-value*	Median forecast of nuclear catastrophe	p-value*
Deterrence				
Deterrence is inherently fragile	0.8	0.78	0.9	0.43
Deterrence is robust	0.78		0.85	
Escalation				
Nuclear escalation is very likely	0.77	0.46	0.8	0.77
Nuclear escalation can be prevented	0.78		0.9	
Disarmament				
We should push for total disarmament now	0.78	0.67	0.92	0.84
Total disarmament should not be an ultimate goal	0.7		0.91	
Nuclear energy				
We should not deter non-nuclear states from developing nuclear energy	0.77	NA	0.89	NA
We shouldn't support nuclear energy in states without nuclear weapons	0.73		0.59	

***Table A85**: Average relative risk for the five general policies (excluding "USA removes sole authority") disaggregated by deterrence and escalation beliefs. *p-value derived from Mann-Whitney U test, evaluating for difference in the distribution of forecasts between respondents choosing each statement, within expert and superforecaster groups.*

[379] Summaries of the full statements are presented here. We suggest reading the full statements, which can be found in Appendix 4.

Statement selected as closest match to views[380]	Crisis communications Network				Failsafe reviews			
	Expert		Superforecaster		Expert		Superforecaster	
	Mean rank	p-value	Mean rank	p-value	Mean rank	p-value	Mean rank	p-value
Deterrence								
Deterrence is inherently fragile	3.4	0.15	1.7	0.005	4.3	0.05	3.3	0.85
Deterrence is robust	3.3		3.5		3.4		4.1	
Escalation								
Nuclear escalation is very likely	3.5	0.75	2.7	0.61	4.1	0.05	3.8	0.31
Nuclear escalation can be prevented	2.8		3.1		3.1		3.9	
Disarmament								
We should push for total disarmament now	3.4	0.20	3.1	0.64	4.4	0.30	3.5	0.58
Total disarmament should not be an ultimate goal	2.7		3.7		3.8		4	
Nuclear energy								
We should not deter non-nuclear states from developing nuclear energy	3.2	NA	3.4	NA	3.92	NA	3.65	NA
We shouldn't support nuclear energy in states without nuclear weapons	3.5		3		7		1.4	

Table A86: *Mean rank (out of 9) for the two most popular policies, disaggregated by beliefs on contentious issues. *The p-values compare the responses for the participants who selected the two responses as being closest to their views (it does not compare experts and superforecasters). The p-value is derived from Welch's t-test, evaluating for difference in the distribution of rank between respondents choosing each statement, within expert and superforecaster groups.*

[380] Summaries of the full statements are presented here. We suggest reading the full statements, which can be found in Appendix 4.

Reciprocal scoring

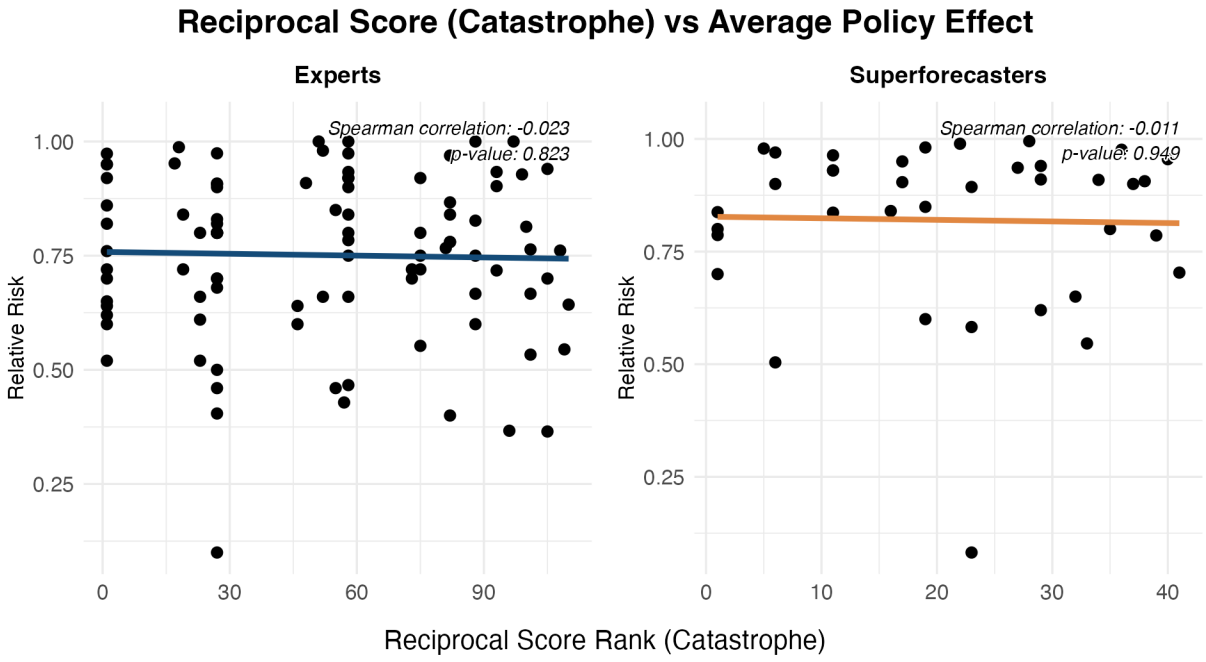

Figure A10: *Correlation between average forecasts of policy implementation (five general policies, excluding Sole Authority) and reciprocal scoring ranks for predicting the expert median forecast of the probability of nuclear catastrophe by 2045.*

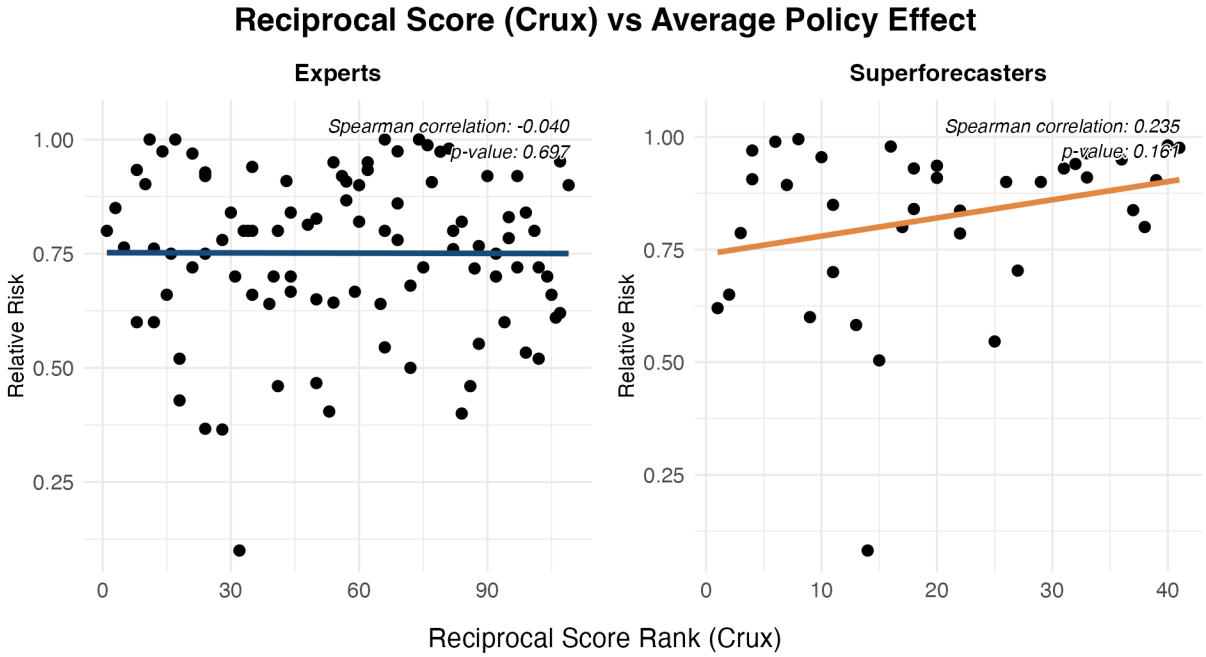

Figure A11: *Correlation between average relative risk of general policies (five general policies, excluding Sole Authority) and reciprocal scoring ranks for predicting the expert median forecast of crux resolution questions.*

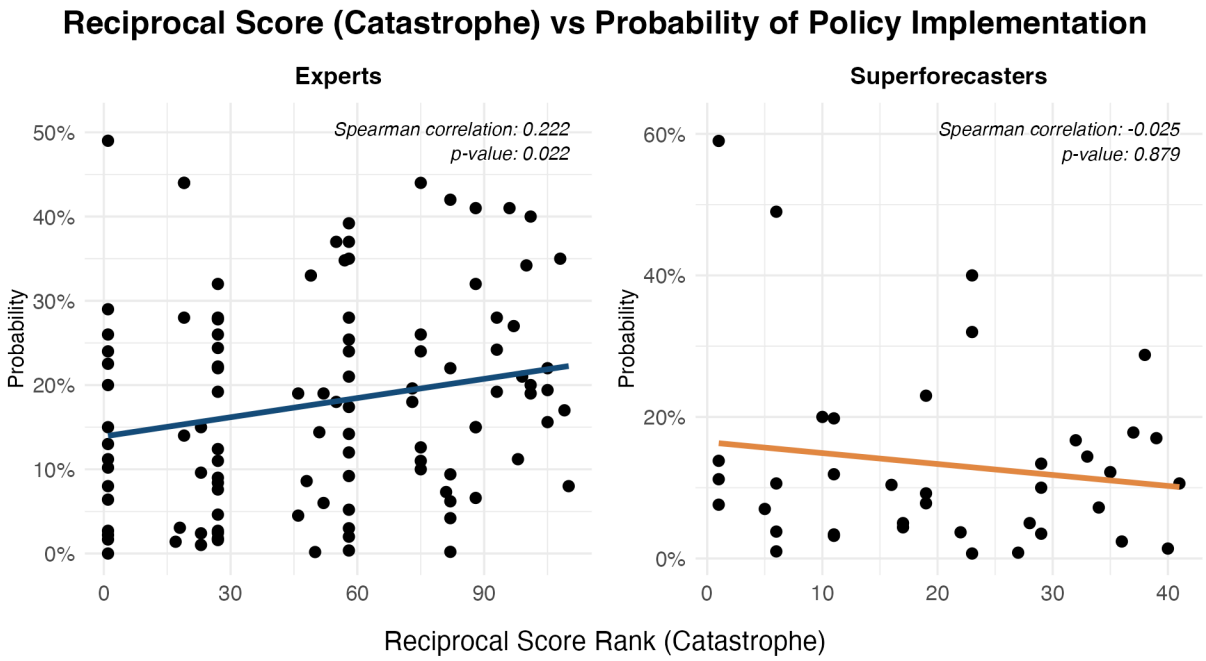

Figure A12: *Correlation between average relative risk of general policies (five general policies, excluding Sole Authority) and reciprocal scoring ranks for predicting the expert median forecast of the probability of nuclear catastrophe by 2045.*

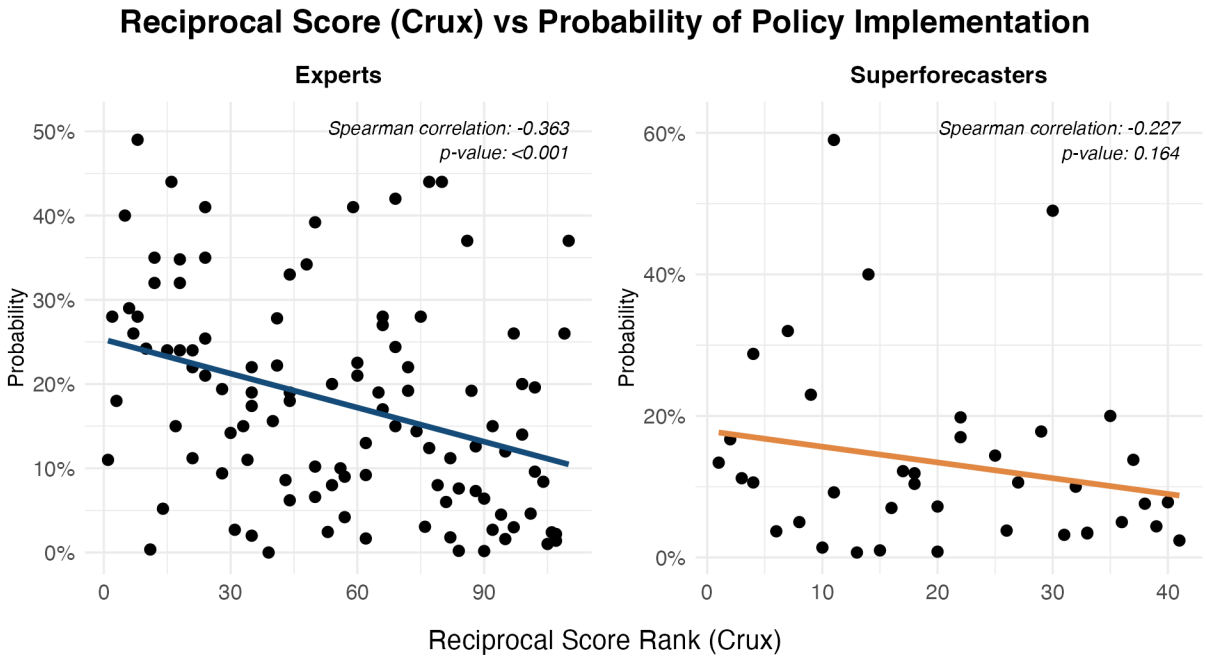

Figure A13: *Correlation between average forecasts of policy implementation (five general policies, excluding Sole Authority) and reciprocal scoring ranks for predicting the expert median forecast of crux resolution questions.*