The Politics and Science of Prevision

This book inquires into the use of prediction at the intersection of politics and academia, and reflects upon the implications of future-oriented policy-making across different fields.

The volume focuses on the key intricacies and fallacies of prevision in a time of complexity, uncertainty, and unpredictability. The first part of the book discusses different academic perspectives and contributions to future-oriented policy-making. The second part discusses the role of future knowledge in decision-making across different empirical issues such as climate, health, finance, bio- and nuclear weapons, civil war, and crime. It analyses how prediction is integrated into public policy and governance, and how in return governance structures influence the making of knowledge about the future. Contributors integrate two analytical dimensions in their chapters: the epistemology of prevision and the political and ethical implications of prevision. In this way, the volume contributes to a better understanding of the complex interaction and feedback loops between the processes of creating knowledge about the future and the application of this future knowledge in public policy and governance.

This book will be of much interest to students of security studies, political science, sociology, technology studies, and International Relations.

Andreas Wenger is Professor of International and Swiss Security Policy and Director of the Center for Security Studies (CSS) at ETH Zurich, Switzerland.

Ursula Jasper is the Policy Officer at Fondation Botna in Switzerland. Prior to this she worked for many years as a Senior Researcher at the Center for Security Studies at ETH Zurich, Switzerland.

Myriam Dunn Cavelty is Deputy Head of Research and Teaching at the Center for Security Studies (CSS), ETH Zurich, Switzerland.

CSS Studies in Security and International Relations

Series Editor: Andreas Wenger

Center for Security Studies, Swiss Federal Institute of Technology (ETH), Zurich

The *CSS Studies in Security and International Relations* series examines historical and contemporary aspects of security and conflict. The series provides a forum for new research based upon an expanded conception of security and will include monographs by the Center's research staff and associated academic partners.

Peacekeeping in Africa
The evolving security architecture
Edited by Thierry Tardy and Marco Wyss

Strategic Culture, Securitisation and the Use of Force
Post-9/11 security practices of liberal democracies
Wilhelm Mirow

Russia's Security Policy under Putin
A critical perspective
Aglaya Snetkov

Negotiating the Nuclear Non-Proliferation Treaty
Origins of the nuclear order
Edited by Roland Popp, Liviu Horovitz and Andreas Wenger

Inter-organisational Relations in International Security
Cooperation and Competition
Edited by Stephen Aris, Aglaya Snetkov and Andreas Wenger

The Politics and Science of Prevision
Governing and Probing the Future
Edited by Andreas Wenger, Ursula Jasper and Myriam Dunn Cavelty

For more information about this series, please visit: www.routledge.com/CSS-Studies-in-Security-and-International-Relations/book-series/CSSIR

The Politics and Science of Prevision

Governing and Probing the Future

Edited by Andreas Wenger, Ursula Jasper and Myriam Dunn Cavelty

Routledge
Taylor & Francis Group
LONDON AND NEW YORK

First published 2020
by Routledge
2 Park Square, Milton Park, Abingdon, Oxon OX14 4RN

and by Routledge
52 Vanderbilt Avenue, New York, NY 10017

Routledge is an imprint of the Taylor & Francis Group, an informa business

British Library Cataloguing-in-Publication Data
A catalogue record for this book is available from the British Library

Library of Congress Cataloging-in-Publication Data
Names: Wenger, Andreas, editor. | Jasper, Ursula, editor. | Dunn Cavelty, Myriam, editor.
Title: The politics and science of prevision : governing and probing the future / edited by Andreas Wenger, Ursula Jasper, and Myriam Dunn Cavelty.
Description: Abingdon, Oxon; New York: Routledge, 2020. | Series: CSS studies in security and international relations | Includes bibliographical references and index.
Identifiers: LCCN 2020008398 (print) | LCCN 2020008399 (ebook) | ISBN 9780367900748 (hardback) | ISBN 9781003022428 (ebook)
Subjects: LCSH: Policy sciences. | Forecasting. | Human security-Forecasting.
Classification: LCC H61.4 .P65 2020 (print) | LCC H61.4 (ebook) | DDC 320.6-dc23
LC record available at https://lccn.loc.gov/2020008398
LC ebook record available at https://lccn.loc.gov/2020008399

ISBN: 978-0-367-90074-8 (hbk)
ISBN: 978-1-003-02242-8 (ebk)

Typeset in Times New Roman
by Wearset Ltd

Contents

Illustrations

Figures

Tables

Contributors

Editors

Myriam Dunn Cavelty is Deputy Head of Research and Teaching at the Center for Security Studies (CSS), ETH Zurich. She is the author of *Cyber-Security and Threat Politics: US Efforts to Secure the Information Age* (Routledge, 2008). Orcid.org/0000–0002–3775–1284.

Ursula Jasper is the Policy Officer at Fondation Botnar. Prior to joining the foundation, she worked as a Senior Researcher at the Center for Security Studies (CSS) at ETH Zurich. Before moving into the global health sector, she had published several peer-reviewed articles, book chapters and a monograph on international politics. Orcid.org/0000–0002–9052–1242.

Andreas Wenger is Professor of International and Swiss Security Policy at ETH Zurich and Director of the Center for Security Studies (CSS). The focus of his main research interests lies on security and strategic studies, the history of international relations and Swiss security politics. Orcid.org/0000–0003–2085–1227.

Authors

Brian Balmer is Professor of Science Policy Studies, Department of Science and Technology Studies, University College London. He has published widely on the history of chemical and biological warfare and is author of *Secrecy and Science* (Ashgate, 2012) and *Britain and Biological Warfare* (Palgrave, 2001). Orcid.org/0000–0002–8130–8423.

Corinne Bara is an Assistant Professor at the Department of Peace and Conflict Research (DPCR), Uppsala University. At DPCR, she leads a project on the impact of ceasefire agreements on the trajectory of violence in war zones. Orcid.org/0000–0001–9831–0573.

Francis J. Gavin is the Giovanni Agnelli Distinguished Professor and Inaugural Director of the Henry A. Kissinger Center for Global Affairs at SAIS-Johns Hopkins University. His most recent book is *Nuclear Weapons and American Grand Strategy* (Brookings, 2020).

Jean-Baptiste Gouyon is Associate Professor in Science Communication at the Department of Science and Technology Studies, University College London. He writes on the history of science in visual media. Most recently he published *BBC Wildlife Documentaries in the Age of Attenborough* (Palgrave, 2019). Orcid.org/0000–0003–2379–0853.

Gunther Hellmann is a Professor of Political Science at Goethe University, Frankfurt am Main, Germany. He is co-editor of *Uses of the West: Security and the Politics of Order* (Cambridge University Press, 2017) and *The Transformation of Foreign Policy* (Oxford University Press, 2016). Orcid.org/0000–0002–4011–7954.

Michael C. Horowitz is Professor of Political Science at the University of Pennsylvania and Interim Director of Penn's Perry World House. He is the author of *The Diffusion of Military Power: Causes and Consequences for International Politics* (Princeton University Press, 2010). Orcid.org/0000–0002–3067–7157.

Sheila Jasanoff is Pforzheimer Professor of Science and Technology Studies at the Harvard Kennedy School. She is author or editor of more than a dozen books, including *The Fifth Branch: Science Advisers as Policymakers* (Harvard, 1990), *Dreamscapes of Modernity: Sociotechnical Imaginaries and the Fabrication of Power* (Chicago, 2015), and *The Ethics of Invention: Technology and the Human Future* (Norton, 2016). Orcid.org/0000–0002–0488–8698.

Peter J. Katzenstein is the Walter S. Carpenter Jr Professor of International Studies at Cornell University. His current research interests focus on worldviews, power, the politics of regions and civilizations, America's role in the world, and German politics. Orcid.org/0000–0001–5810–1662.

Nicole Klenk is an Associate Professor at the Departments of Physical and Environmental Sciences and Political Science, University of Toronto. Her current research interests focus on the politics of environmental knowledge production. Orcid.org/0000–0001–8224–6992.

Matthias Leese is a Senior Researcher at the Center for Security Studies (CSS), ETH Zurich. His research focuses on the social effects produced at the intersections of security and technology. His work covers various application contexts of security technologies, including borders, policing and R&D activities. Orcid.org/0000–0002–7153–7783.

Maria Carmen Lemos is Professor for Environment and Sustainability and Co-Director of the Great Lakes Integrated Sciences and Assessments Center at the University of Michigan. Her research and practice focus on the usability of scientific knowledge in decision-making, especially applied to climate adaptation. Orcid.org/0000–0001–6686–730X.

Filippa Lentzos is a Senior Research Fellow at King's College London, with a joint appointment in the Department of Global Health and Social Medicine

and the Department of War Studies. She is the editor of *Biological Threats in the 21st Century* (Imperial College Press, 2016). Orcid.org/0000–0001–6427–4025.

Stephen C. Nelson is an Associate Professor at the Department of Political Science at Northwestern University. He is the author of *The Currency of Confidence: How Economic Beliefs Shape the IMF's Relationship with Its Borrowers* (Cornell University Press, 2017). Orcid.org/0000–0002–5965–0273.

Jonas Schneider is a Senior Researcher in nuclear policy and nonproliferation at the Center for Security Studies (CSS), ETH Zurich. His research focuses on the causes and consequences of nuclear weapons proliferation and on the role of political leaders in international affairs. Orcid.org/0000–0003–2715–0669.

Acknowledgements

Despite the growing demand for policy-relevant academic work in general and for future-oriented knowledge in particular, academia's contribution to future-oriented policy-making remains contested. What type of future knowledge do policy-makers seek and what type of knowledge can academia provide? This book brings together contributions by an interdisciplinary group of international scholars to answer some of these questions. It all started with a two-day interdisciplinary workshop organized by the Center for Security Studies at ETH Zurich in 2016 and was developed further in the subsequent years in collaboration with several senior colleagues contributing insight from different empirical fields.

We are most indebted to our authors: for agreeing to contribute to this ambitious project; for accepting the limits and constraints such a project inevitably brings about; for considering our suggestions and comments; for being patient about the editing process; and finally, for delivering such rich content. We feel privileged to have worked with all of them, and this volume is a product of their devotion and commitment.

We are furthermore very grateful for the invaluable editorial assistance provided by Julia Hofstetter, Boas Lieberherr and Jasper Frei, for the help with the graphical elements by Miriam Dahinden and last but not least, for the support of Andrew Humphrys, Senior Editor at Routledge, and Bethany Lund-Yates, Routledge's Editorial Assistant.

Part I

Introduction

1 Governing and probing the future

The politics and science of prevision

Andreas Wenger, Ursula Jasper and Myriam Dunn Cavelty

To muse about the things to come is a common characteristic of human life, an anthropological constant, regardless of historical epochs or cultural belongings. No matter whether the prevalent notions of time and cosmology cast the future as 'God's predestined gift' or as an 'empty territory that is to be settled' (Adam 2010), human beings seek to anticipate and prepare themselves for what is lying ahead. Beyond the many 'small futures' that get enacted continuously in people's day-to-day lives, social and political communities also like to envision 'big futures' with much larger temporal and spatial horizons (Michael 2017).

That way, politics and the wish to assemble future knowledge through scientific means are intricately interwoven. The desire to govern the future through science arose in parallel to the rise of the modern nation state and a more technocratic and scientific approach to public administration in the nineteenth century. With the dawn of modernity, foreseeing and preparing for possible future developments became a key task for policy-makers, bureaucrats and scholars alike. Today, future knowledge offers the administrative basis and justification for state intervention and societal, military and economic planning (Bell 1964; Seefried 2015). To govern the future, both with regard to long-term strategic planning and the prevention of and preparation for unforeseeable ruptures and crises, can be seen as the political task par excellence for today's states (Landwehr 2018: 38). It is, after all, the promise to order and govern not only the present, but to anticipate, manage and secure the future that gives legitimacy and a 'raison d'être' to the modern state (Henne *et al*. 2018: 9).

Science and politics are no easy bedfellows, however. This is largely due to the different knowledge conceptions that are at work in the two fields, or what Maasen and Weingart describe as 'knowing' vs. 'deciding':

> The mode of science is oriented to the continuation of systematic knowledge production, to learning and, thus, to the questioning of existing knowledge. The mode of politics, by contrast, is oriented to the closure of public conflicts through compromise, using knowledge strategically as it unfolds.
>
> (Maasen and Weingart 2005: 7)

As a consequence, the knowledge that is produced in science is not necessarily the same as that required by politics.

In addition, there is a disparity in the temporal orientation of decision-makers and scholars. Adam describes this as a disjuncture between 'the futurity of social life' (and one might add: futurity of political life) and 'the present and past-based empirical study' of this life in the social sciences and history (Adam 2010: 362). Gavin provides a similar explanation to describe why decision-makers rarely draw upon the conclusions provided by historians: 'Forced to make difficult choices under enormous time pressures, government officials want "usable" knowledge that provides guidance for making the best decisions. Understandably, they seek certainty, particularly about the future, and are grateful for clear-cut rules and parsimonious explanations' (Gavin 2008: 163; also Brands 2017).

And yet, perhaps paradoxically, we observe growing demand for and interest in governing and probing the future at the intersection of politics and academia today. While in politics the openness and temporal horizon of the future are contested, in academia we witness renewed reflection and debate about the purpose, epistemologies and methodologies of probing the future. The politics and science of anticipating the future are clearly intertwined – and it is the goal of this book to inquire into the epistemological possibilities and pitfalls of prediction, while at the same time assessing the political and ethical implications of future-oriented policy-making across different policy fields. This introductory chapter provides the background to this endeavour, situating any attempt to understand the future for political reasons in a larger socio-political context.

Governing the future: the co-constitution of future visions and politics

Different visions of the future as well as social and political orders and governance mechanisms evolve together over time. Accounts of past futures, i.e. historical imaginaries of a possible future, tell us a lot about the historical political and cultural circumstances under which they were sketched, regardless of whether they later prove to be accurate or not. From them, it becomes visible which ideational patterns, knowledge regimes and political orders gave rise to a particular sketch of the future. Thus, pre-modern prophecies and divinations tell us more about then-prevalent religious cosmologies and eschatology than about the veracity of expectations (Adam 2010). The same can be said about utopias or dystopias: they are not primarily meant to predict a state of the world that is to materialize at a specific point in time, but rather contain a proposal for an alternative order to the present one (Landwehr 2018: 39).

That humans accommodate and locate themselves in a narrative mesh of past, present and future holds across time and culture. What differs is the specific temporal horizon of the imaginaries to which they adhere: Either their life script is organized around certain memories of the past or it is subordinated to some kind of futurity (Hölscher 2016: 91). Unlike pre-modern societies which

seem to have predominantly oriented themselves towards the past, modern societies are characterized by their orientation towards the future and a belief that said future can and even should be shaped by actions in the present. Future-orientedness as we commonly understand it today is therefore a phenomenon closely tied to the modern era (Jordheim 2012: 153). At the dawn of modernity, a process of reordering the temporal thinking was set in motion in the Western world that marked the beginning of the parallel rise of a rapidly growing interest in the future and the industrial nation state. It is that intersection we need to understand to be able to situate our own undertaking in the flow of history.

The advent of modernity: a new openness of the future and the rise of the industrial nation state

With the advent of modernity people's 'space of experience' and their 'horizon of expectation' disintegrated, as Koselleck explains: In the post-Enlightenment period individuals and communities could no longer primarily rely on tradition, previous experience and past historical knowledge to cope with the new and the coming, because the accelerated societal, political and cultural upheavals were too fundamental and too swift. Increasingly, history came to be seen as fundamentally different from the present and the future (Koselleck 1989: 349ff.). The new epoch reflected a new temporality – a linear, directional understanding of time – and spurred the perception of a fundamental openness of the future. This enabled a form of anticipation of the unfolding and a propensity to imagine and proactively shape the future that had been unknown in previous historical periods (Koselleck 1990: 541).

The preoccupation with the upcoming greatly expanded in the context of the Western state building process that not only established state bureaucracies – tasked with upholding the internal (police) and external (army) state monopoly of violence and the establishment of a tax system – but a more scientific and technocratic approach to public administration and economic affairs more generally. The new interest in expectations and plans was further facilitated by an emerging enthusiasm in numbers and numerical analyses of demographical, economic or agricultural trends. The resulting upsurge of statistics reflected a broader ideational shift characteristic for the era of the Industrial Revolution, as Hacking explains: 'The acquisition of numbers by the populace, and the professional lust for precision in measurement, were driven by familiar themes of manufacture, mining, trade, health, railways, war, empire' (Hacking 1990: 5; Agar 2003).

Projects of state modernization and rationalization vastly heightened the demand for systematic and structured academic advice geared towards the future and increased the pressure put on academia to provide such insights – a task that was facilitated by the expansion and differentiation of the academic landscape and the growing importance of an empiricist epistemology in the late nineteenth century. Foreseeing and preparing for possible future developments became thus key tasks for scholars and bureaucrats and the administrative basis and justification for the interventionist planning activities of states

(Seefried 2015: 40). State intervention peaked in the war economies of World War I and in post-depression era efforts to avoid similar economic crises by developing more efficient tools to anticipate and steer economic development. The economic ideas of anticyclical fiscal spending and fiscal policy interventions developed by John Maynard Keynes were especially influential in fostering a future-oriented, prognostic perspective on processes of socio-economic planning (Van Laak 2008).

The trend towards anticipating, planning and engineering the future was intensified further in the years to follow, when notions of technocratic rationalization, resource optimization and societal engineering emerged simultaneously in Europe and the US. Under both fascist and communist rule, these ideas soon acquired a totalizing determination as revolutionary blueprints of a new socio-political/racial order, which drew upon large amounts of newly generated statistical and planning data. They culminated in the brutal race policies, forced displacements and genocidal policies emblematic for both regimes, as well as in many of their totalitarian architectural, infrastructural and engineering projects. While the totalitarian character of planning and societal engineering was thoroughly discredited thereafter, scientific approaches to the future kept blossoming on a different basis in the decades after World War II (Van Laak 2008; Seefried 2015).

The golden age of future studies: big science and the dark side of modernity

The 1950s and 1960s are often described as the 'Golden Age' of future studies. Geopolitical, technological and social drivers contributed to the parallel rise of big social and political planning ambitions, on the one hand, and big science, on the other. First, the economic reconstruction and recovery efforts of the post-war years led to big investments in research and a large growth in the number of trained scientists working in a diversified landscape of research institutions on both sides of the Iron Curtain. This in turn triggered a phase of professionalization and specialization as well as a general 'science boom' and blossoming of academic output (Rossiter 1985; Holloway 1999). Second, this trend was fostered by the establishment of 'big science' projects commissioned and funded by big states, resulting in a dense entanglement of academic work with governmental interest. Early on, and building upon vast wartime efforts such as the *Manhattan Project* that had led to the development of the US atomic bomb, these 'big science' project concentrated on the defence sector. Later, however, they rapidly spread to a wide variety of social and natural sciences disciplines (Reynolds 2010; Solovey 2001; Galison 1992).

Third, the invention, improvement and fast diffusion of computers contributed heavily to the rise of future studies in the decades after World War II. New technologies made the collection, structuring and processing of large amounts of data possible and raised the hope that computational models could be built to anticipate future developments (Agar 2003; Edwards 1996). Fourth,

the growing interest in the future was not only driven by material factors but also stimulated by new ideological-intellectual currents that gained hold in the middle of the twentieth century, as Andersson and Rindzevičiūtė explain convincingly:

> Different strands in futures research stood in either striking proximity to or critical engagement with modernization theory, which garnered authority in both social science and politics by the early 1960s. Similarly important were emerging postulates of rationality, created with an aim to explain and foretell social developments so that desirable ones could be privileged and undesirable ones avoided. Through such approaches in the social sciences, the future reemerged as a scientific interest, but also as an object of control and intervention.
>
> (Andersson and Rindzevičiūtė 2015a: 3)

Several of these trends became manifest in the newly founded interdisciplinary research domain of cybernetics. Based on the premise that natural, social and technological processes and systems all behave according to similar patterns, this new meta-discipline aimed to uncover the information transfer and underlying rules and mechanisms within a certain system but also between the system and its environment. The proximity to the future studies field is evident: If all systems behave according to a set of specific rules and information transmission patterns, this would allow the simulation and modelling, and ultimately also the predicting and forecasting, of natural and social actors' behaviour and even of complex systemic processes. Unsurprisingly, these convictions fed into an outright and arguably quite paternalistic euphoria for steering, planning and social engineering that culminated in the 1950s and 1960s (Seefried 2013, 2015; Van Laak 2008).

While large parts of this cybernetic-inspired research remained staunchly empirical and positivist in its outlook, there was also new space for a critical-normative investigation of alternative, emancipatory, even utopian futures. Writings within this latter research strand provided discursive space for discussions about multiple possible futures, change and agency vis-à-vis mankind's futurity as well as about participation, responsibility and empowerment to actively shape what is to come. At the same time, and in light of new cultural currents, non-traditional political actors had begun to fundamentally problematize the orthodoxy of Western political and economic principles and had called for a discontinuation or at least recalibration of the capitalist orientation on growth and consumption (Radkau 2017: 242ff.).

The 1970s witnessed the emergence of a new perception of the 'dark side of modernity' (Giddens 1990: 9) in the West, as the almost mythical expectations raised by the positivist steering and planning ambitions of the previous decade had remained unfulfilled. The appearance of hitherto unknown, potentially existential risks to humanity and the planet's ecosystems triggered apocalyptic scenarios and future scepticism among many in the Western world (Beck 1986).

The pessimistic economic and ecological forecasts contained in the widely acknowledged 1971 report 'The Limits of Growth' by the Club of Rome nurtured these concerns – despite strong criticism of the report's underlying methodology and data basis (Seefried 2015). The future was no longer considered an untouched space to be colonized, but came to be seen as a 'crowded territory', filled with the actualized desires, hopes and fears of previous generations (Adam 2008: 115).

A contested future: between visions of colonizing and visions of abolishment

Since the – unforeseen – ending of the Cold War, the status of the future as a point of orientation and its openness has remained contested – vacillating between visions of colonizing and visions of abolishment. The end of the bipolar superpower confrontation led some to envision a new and open globalized – perhaps even cosmopolitan – future freed from the ideological chains of the past (e.g. Blechman 1998; Held 1995a, 1995b). Others foresaw 'the end of history' and a closure of political futures and future possibilities, because the victory and universalization of the liberal democratic order represented the final stage in the ideological evolution of mankind (Fukuyama 1992). While the latter left little room (and need, some would say) to shape and design trajectories toward the future, the former contained a far more activist understanding of designing, governing and even colonizing of what is yet to come. It opened up scope for a – perhaps even participatory – 'future imagining' and 'future making'. According to such an understanding, perceptions of the future not only provide orientation between the past – as a source for the extrapolation of knowledge, the present – as the space for planning and decision-making, and the future – as the teleological goal. They also blend 'the descriptive and the performative' (Nelson *et al*. 2008). By producing and acting upon knowledge of the future, we might actually change the very course the future takes – or at least attempt to shape and forge it. Thus, prophecy and control converge, as Choucri argues: 'The possible/desirable becomes the domain of policy planning which, in turn, results in some institutionalized imperative for forecasting. Viewing the future involves, to some extent, creating it' (Choucri 1978).

However, in light of new dramatic challenges such as climate change, resource scarcity or emerging new diseases the imaginaries of a possible future and the possibility of human control have become more pessimistic, as Assmann observes:

> In many areas such as politics, society and environment, the future has lost its lure. It can no longer be used indiscriminately as the vanishing point of wishes, goals and projections. … The future, in short, has become an object of concern, prompting ever-new measures of precaution.
>
> (Assmann 2013: 41)

Digital technologies and their interlinkages with newly emerging technologies in the fields of AI (artifical intelligence), space-based technologies and quantum computing promise great benefit, but also come with increasing vulnerabilities and great uncertainty (Dunn Cavelty and Wenger 2019). Moreover, the technologies that we invent and implement today potentially trigger such momentous, delayed consequences that the 'temporal category of the future is being abolished and replaced by that of the extended present' (Nowotny 2018: 51).

Perhaps yet another fundamental alteration in our temporal thinking is under way, creating a paradox at the science–policy interface: The rise of the precautionary principle and the concept of resilience in many public policy fields reflect a growing feeling among policy-makers that in a world of great complexity and interconnectedness risks cannot always be controlled and disruptions and discontinuities are inevitable (Dunn Cavelty *et al*. 2015). At the same time, reminiscent of earlier beliefs, the current advances in the data sciences come with the promise that the integration of new analytical tools together with the availability of new data and rapidly growing computing power will allow to address the future in policy-making on an unprecedented scale and speed (Hofstetter and Lieberherr 2019).

In sum, policy-makers – at least in the West – seem to live in a world in which the horizon of possibilities is shrinking at the very time that the technical possibilities to influence and shape the immediate future are rapidly expanding. It is within this context marked by new technological risks and opportunities and a related, new awareness for the future in politics and academia that this book is situated.

Probing the future: epistemological choices and their socio-political consequences

Policy-makers seek knowledge as a form of guidance for policy-decisions that are necessarily geared towards the future. They require concrete and often specific knowledge that enables them to take decisions which, in many cases, will only become manifest in the mid-to-long-term, and to proactively manage the future with all its uncertainties and unknowns (Bobrow 1999; Byman and Kroenig 2016). That means that policy-makers have little choice, they need access to scientifically robust knowledge and future-oriented policy-advice to muster public support for solutions of increasingly complex policy problems, from modelling climate change and explaining the causes of the recent global financial crisis to preventing deadly conflicts and reducing urban violence. Scientific progress and the invention of new technologies come with the promise of considerable economic and social benefits, but at the same time contain considerable technical, social and political risks.

This is one of the reasons why almost all academic disciplines from the social sciences and humanities to the natural sciences and engineering are increasingly expected not only to deal with politically, economically, socially

relevant issues, and to commit to outreach and science communication strategies, but also to preview, anticipate and provide solutions to future problems and challenges (Kristof 2014). At the same time, whenever a major crisis or turning point in global affairs occurs, it is particularly the social sciences and humanities that are criticized for failing to predict key global events. Prime examples are IR (International Relations) scholars who did not foresee the end of the Cold War; Middle East experts who did not anticipate the Arab Spring; or EU scholars and political scientists who failed to foresee developments such as Brexit or the rise of populism in recent years.

Such criticism is not new and at times it goes along with growing pessimism towards science, technology and experts more generally. For many years now, voices from both within and outside the academic field have criticized the social sciences for focusing on the wrong issues and being too absorbed in questions that have little or no policy-relevance; for failing to generate the kind of future-oriented knowledge that allows policy-makers to take action to avoid future crises. According to this view, scholars should strive for a better toolkit to solve pressing policy problems, instead of getting lost in philosophical and meta-theoretical debates. Disciplines such as Political Science, International Relations, Security Studies or History are strongly pressured to justify their funding by being policy-relevant and by making future-related, forward-looking contributions (George 1993; for a different view see Zambernardi 2016).

Future studies and future politics

We see that the future as an object of scholarly contestation is back in the social sciences and beyond – stimulated by increasing demand for policy-relevant work in general and for future-oriented knowledge in particular; by a process of introspection why many disciplines failed to anticipate some of the key global events of recent decades; and by the emergence of new analytical and technical tools for prediction and anticipation. Today we observe renewed reflection and debate about the intricacies and fallacies of probing the future (Ward 2016; Montgomery 2016) in a time of complexity, uncertainty and seeming unpredictability.

This new impetus spurs new questions and contributes to an innovative research agenda on future studies and future politics. Which means do we possess to generate knowledge about the future? What type of future knowledge do policy-makers seek and what type of knowledge can academia provide (Avey and Desch 2014; Desch 2015)? What are the anticipatory practices and modalities prevalent in specific cultural and political contexts and policy domains? Do we have to question foreseeability in (international) politics altogether (Gaddis 1992; Taleb 2009) and instead turn to precaution, preparedness and resilience (Aradau 2014; De Goede 2008)? Do we need to adapt our methodologies and turn to game-theoretical mathematical modelling (Bueno de Mesquita 1998, 2002, 2010)? Will ‘big data’ analytics pave the way for ‘cybernetics 2.0’ (Helbling *et al*. 2019;

Kitchin 2014; Jäger 2016)? Or is the anticipation and forecasting of the future an – individual or crowd-based? – skill that needs to be cultivated, trained and practised (Tetlock and Gardner 2016; Mellers *et al*. 2015)?

In light of these questions and puzzles, this book brings together contributions by an interdisciplinary group of international scholars from Political Science/International Relations, Security Studies, International Political Economy, International History, Sociology of Technology and the Life Sciences. The research endeavour profited a lot from the rich body of work on the future that has emerged in the recent decade in history, sociology and political science. This includes inquiries into the role of risk and uncertainty in International Political Economy (Beckert 2013; Kessler 2008; Nelson and Katzenstein 2014); critical security scholars' work on the governance of risk (Aradau and van Munster 2001, 2007); qualitative (Berenskoetter 2011; Meyer 2011; Neumann and Øverland 2004; Feder 2002; Montgomery 2016) and quantitative (Bueno de Mesquita 2002; Doran 1999) theoretical work in IR more traditionally; empirically driven analyses in specific subdisciplines of political science (Montgomery and Mount 2014; Montgomery and Sagan 2009; Ward 2016; Ward *et al*. 2010; Ward *et al*. 2013); or psychological (Mellers *et al*. 2015; Tetlock and Gardner 2016) as well as sociological and historical studies (Jasanoff 1994; Jasanoff and Kim 2015; Andersson and Rindzevičiūtė 2015b; Seefried 2015).

Also, numerous studies on future-thinking have inquired into the politics of anticipating the future: Who has the power to decide which future is desirable (Grunwald 2008; Brown *et al*. 2000)? Power and hierarchy at work in bureaucracies and the public often predefine whose predictions and scenarios are heard and gain traction in policy-making (Connelly *et al*. 2012; Connelly 2008; Andersson and Rindzevičiūtė 2015b; Radkau 2017). Alternative scenarios can have far-reaching political implications and specific previsions are sometimes bluntly (mis)used for (partisan) political purposes. Across time and space, the presumed authority of scientists, policy-consultants and political experts has been used by policy-makers to limit the discursive space for disagreement and opposition, thereby enabling decisionist modes of government (Habermas 1968; Schelsky 1970).

The current literature on future thinking in politics and IR distinguishes three different types of 'forward reasoning': forecasts, predictions and scenarios (Choucri and Robinson 1978). In sociology, science and technology studies, and economics, we also find concepts such as expectations, promises, imaginaries, visions and fictions which all share a more normative valuation (Konrad *et al*. 2017; Beckert 2013). In addition to these broader distinctions, future-oriented studies differ along several other analytical dimensions: the role of contingency vs. ceteris-paribus conditions; agency vs. structural determinism; their normative-prescriptive content; or the time horizon (short-term/long-term) under consideration (Bernstein *et al*. 2000; Grunwald 2008; Meyer 2011; Becker *et al*. 2016). However, this attempt at categorizing the different forms of future thinking cannot conceal that the terms are often used interchangeably and that the different analytical standpoints and assumptions remain hidden. Foregrounding

those by making different ways of thinking about the future explicit is where this book hopes to make its contribution.

The goal and structure of the book

The goal of the book is to inquire into the renewed interest in governing and probing the future at the intersection of politics and academia. In the second part, the book adds to an understanding of the diversity and pluralism of contemporary future-oriented work, systematically analysing the underlying epistemological assumptions and ethical and political implications of different academic perspectives on and contributions to future-oriented policy-making. In the third part, the book discusses the role of future knowledge in decision-making across different empirical issues, analysing how prediction is integrated into public policy and governance and how in return governance structures influence the making of knowledge about the future.

That said, Part II of the book is not just about the science of prevision, as Part III is not only about the politics of prevision. The point is rather that the politics and science of anticipating the future are closely interlinked: All of the book's contributions integrate the two analytical dimensions – the epistemology of prevision and the political and ethical implications of prevision – in an attempt to analyse how the science of addressing the future is integrated into the politics of anticipating the future and vice versa. This way, the book would like to contribute to a better understanding of the complex interaction and feedback loops between the processes of creating knowledge about the future and the application of this future knowledge in public policy and governance.

Academic perspectives on and contributions to future-oriented policy-making

Part II of the book discusses different academic perspectives on and contributions to future-oriented policy-making. The first two chapters address the two main analytical dimensions – the role of prediction at the intersection of power and democracy and the epistemology of prediction in the social and political sciences – in greater detail. The next three chapters introduce the reader to some pressing 'practical issues' of future-thinking at the science–policy interface. They look at prevalent biases; examine the role and contribution of thinking historically for policy; and provide a typology of different forms of future studies.

Opening Part II of the book, *Sheila Jasanoff* analyses how the predictive politics of future-making fundamentally alter existing practices of constitutional democratic government by upsetting three archetypical foundations: its materiality, its presentism and its localism. The outcomes of contemporary political struggles, Jasanoff argues, are no longer conceived as immediate, tangible and available for popular evaluation and judgement. Instead, contemporary political

contestations revolve around collective political imaginations of the future in which different, often even conflicting or opposing, visions are negotiated. These negotiations – what one might term the 'politics of the future' – thus continually enact and engender possible 'dreamscapes' and provide a space in which visions of the future originate and flourish or are met with resistance. The consequences of these negotiation processes are far-reaching, because once a certain vision of the future is embedded and acted upon, it co-constitutes and precipitates a specific future trajectory, while necessarily also precluding 'alternative futures'. It is crucial to understand the power-laden, hierarchically structured nature of these negotiations in order to restore and reclaim democratic participation in the politics of the future. But the changes brought about by the rise of science and technology as major forces in world-making go even beyond the domestication of the future for present-day political action. Predictive politics have also fundamentally changed the objects of governance, the instruments of political intervention, and the political subjects and polities. Drawing on her rich work in Science and Technology Studies (STS) and political theory, Jasanoff shows how prediction as a new form of governance uproots existing practices of constitutional government, brings new questions of trust and accountability into national and global debates, and spurs new movements in political and social thought that amount, in effect, to a reconstitutionalizing of contemporary politics (Jasanoff 2020).

Following this, *Gunther Hellmann* introduces a pragmatist perspective on foresight and hindsight that conceptualizes knowledge as 'know how' that is largely the same about the past, the present and the future. Explaining backward and predicting forward reflect a similar narrative structure in which concepts ('why' questions) and facts ('what' questions) are 'hanging-together' in some form. Knowledge about the past, present and the future are all based on acknowledgement and applied by pragmatist problem-solvers – be they policymakers or academics – to solve some problem in order to cope. Such a perspective of redescriptive sense-making, Hellmann argues, offers a different perspective on the future than both a perspective from the natural sciences – in which the future needs to be discovered and invented – as well as from the perspective of a positivist and realist social science point of view – which separates concepts ('why' questions) and facts ('what' questions). While positivists use probabilistic vocabulary grounded in theory-based backward-looking explanation, thereby closing the past by getting it right or wrong, pragmatists opt for the expansion of the horizon of possibility, encouraging human agency and creativity (Hellmann 2020).

Michael Horowitz addresses the issue of cognitive biases in future thinking. To structure our understanding of how biases shape our ability to forecast, he addresses three areas. The first is about the object. Some things – those that occur with a certain regularity – are easier to forecast than others, such as emotional acts. The second is about the type of individual, group or organization which does the forecasting in order to tackle well-known individual or group biases. The third is about the methodology that is used. Each of the three areas

come with their own challenges, but many of them can be overcome. If the possibilities and pitfalls are addressed at the very beginning of a forecasting process and expectations about what type of knowledge a given process can generate are an important part of the communication between policy and analysts, then the overall validity, legitimacy and efficiency of forecasting activities can be improved (Horowitz 2020).

The relationship between historians and policy-makers – or for that matter history and policy-making – is an uneasy one, *Francis J. Gavin* reminds us in his chapter. Policy-makers demand certainty, prediction and actionable knowledge, whereas most historians are wary about the political misuse of historical analogies, see their primary role as one that confronts and challenges power, and often focus on the underrepresented voices without power. Yet a historical sensibility, Gavin argues, can be helpful to policy-makers and act as bridge between the past and the present. History is not about policy relevance per se, but it helps to develop a perspective of public-mindedness. Thinking historically goes along with an appreciation that history is not linear, that at times it accelerates in unanticipated ways, that decisions need to be taken in a context of complexity and specificity and therefore may well have unintended consequences beyond the immediate issue, time and place. Historians are pragmatists in so far as they combine a macro-view with a micro-view and events with causes in a narrative that connects the past with the future (Gavin 2020).

Myriam Dunn Cavelty's chapter looks at the assumptions and expectations that drive the applications of different scenario planning methods in bureaucracies, moving in three steps from context to practice to impact. In the context of an environment dominated by risks and different levels of uncertainty, relevant actors in public policy employ two different forms of scenarios for future planning. The first type is used for risk assessment, which is then typically used as an input for contingency planning. The second type is used to depict possible future situations in a narrative way, used more often as a basis for the development of long-term strategies. The most substantial difference between these practices is the type of knowledge sought to build them. In the first type, scenarios are understood as 'adverse event illustrations' and are thus based on 'secured' knowledge, which relates to experiences made in the past. In the second, a group of usually diverse people is brought together in order to be creative and imaginative in the process of drafting visions of the future. Interesting and somewhat paradoxical dynamics are revealed: Actors in public policy mainly strive for actionable, 'secure' knowledge, but they also know quite well that the results obtained are much higher in uncertainty than the methodologies suggest. Therefore, they start acting accordingly: by managing the risks of being wrong about risks. Due to this awareness, the future and status of 'old-school' prediction is potentially declining. However, a destabilization of the belief that the future can be known also opens up new possibilities for public policy, such as the establishment of inclusive, interdisciplinary and democratic forecasting exercises in many different areas of policy-making (Dunn Cavelty 2020).

The role of prediction in public policy and governance: empirical perspectives across different policy fields

Part III of the book analyses the role of prediction in public policy and governance, illustrating how risk and uncertainty are dealt with across different policy-fields – from climate, health and markets to bio- and nuclear weapons, civil war and crime. It discusses whose predictions are integrated how deeply into what forms of governance systems and what consequences this has for the making of future knowledge, on the one hand, and the socio-political order on the other. In order to make the empirical chapters comparable and systematic, all authors structure their chapters around the two dimensions of epistemology and politics.

Opening Part III of the book, *Maria Carmen Lemos* and *Nicole Klenk* analyse the complexities of climate adaption decision-making at the science and policy interface, where the uncertainties of the scientific models interact with the uncertainties of policy-making. Global climate models from a scientific point of view leave little room for doubts that climate adaption is warranted. Yet most climate adaption decisions are taken at the local and national levels, where the uncertainties of the models become bigger and the policy trade-offs with other socio-economic and political risks and interests are more pronounced. Within this broader context, the two authors show how the knowledge that underpins decision-making is co-produced by science and policy, at times paralysing politics while politicizing science. They highlight the political and ethical consequence of adaption research and policy-making summarizing three case studies. These case studies show that the climate models may empower technocrats to have a disproportionate influence in decision-making over social and political distributional conflicts; that local attempts to mobilize adaptions capacities are often not in alignment with planning at higher levels of government (resulting in plans without implementation); and that vulnerability assessments at the local level may have unintended consequences, producing risky knowledge that may change property values, creating legal uncertainties as regards who is liable for such risks (Lemos and Klenk 2020).

Ursula Jasper demonstrates how governing and managing the uncertain future has become an increasingly important reference point in individual and global public health. She argues that both domains – while building upon different methodologies and tools – are driven by a growing 'anticipative medicalization': They are shaped by attempts to implement comprehensive and all-encompassing networks of diagnostics and disease surveillance that allow fewer and fewer risks to our well-being – from defective genes to newly emerging pathogens – to go unnoticed. This development has largely been enabled by the unprecedented progress in digital health technologies and artificial intelligence and by the accumulation of massive amounts of health related data. Yet, while we currently witness an almost unfettered optimism in technological feasibility and the benefits of these advances, many fundamental ethical and political-regulatory questions remain unsolved (Jasper 2020).

Peter J. Katzenstein and *Stephen C. Nelson* take the fact that economists failed miserably in anticipating the 2008 financial crisis as a starting point for an analysis of financial market governance and the role economic models play within these markets. The looming catastrophe of uncontrollable instability, they argue, reminded markets players and policy-makers that we live in a world of risk *and* uncertainty, in which pragmatic international actors needed to rely on social conventions and institutions to cope with epistemic uncertainty and guide future-oriented decision-making. As a corollary, the crisis should remind economists that their models do not only analyse markets, but at the same time alter them. Recognizing the ambiguity of financial markets, stabilized by self-validating feedback loops between economists, market players and policy-makers, economists should put the social back into the science that analyses markets. The authors use two case studies – one on a public actor (the US Central Bank), one on a private actor (rating agencies) – to highlight that financial markets are deeply intertwined with social institutions and conventions and that out of a process of social interaction a fictional future emerges that in the form of discursive politics helps to govern future uncertainty and adapt the post-crisis market order (Katzenstein and Nelson 2020).

In their examination of the role of popular culture in imagining future bio-threats, *Filippa Lentzos*, *Jean-Baptiste Gouyon* and *Brian Balmer* turn to a policy field characterized by growing concern about potential new threats and erosion of the barriers to bio-weapons development and use, on the one hand, and almost no public knowledge about past weapons programmes and deliberate outbreaks, the intentions and motivation of potential malevolent state and non-state actors, or on-going public but secret assessment of threats by other states as regards method, data and outcome, on the other. The authors show how in such situations public actors like NATO and the Pentagon have turned to science fiction to explore and imagine how new technologies may impact on future military operations. In such indeterminate contexts science fiction may play an important role in the wider process of anticipatory knowledge production. Novels and movies are an especially accessible source of imagined futures, because they focus on the human dimension – not technology – and on non-linear dynamics in the evolution of technological risks and threats. More research is needed, the authors conclude, to better understand how science fiction influences the political discourse about bio-weapons and how it can help to develop ideas about their control and elimination (Lentzos *et al*. 2020).

Corinne Bara offers an overview of the subfield of conflict research dedicated to the prediction of civil war and political violence. Civil wars are a hard target to predict, because they are rare events, result from people breaking rules, and are often triggered by unpredictable human behaviour. The subfield shares methodological and epistemological foundations that are characterized by a positivist paradigm of scientific research, natural-scientific and mathematical approaches and sophisticated computational models. Building on a conviction that the limits of prediction are better explored and tested than simply assumed, the literature treats explaining the past and predicting the future as two distinct

tasks. Risk factors identified in past conflicts may fail to predict in unseen (future) data. As consequence, the standard procedure for forecasting the onset of war relies heavily on the 'out-of-sample' evaluation of the predictive (statistical or algorithmic) models. As regards the question how academic civil war prediction can and should influence policy-making, Bara concludes, the primary contribution so far is cutting-edge methodological expertise. The development of more directly policy-relevant predictive research remains – with a few notable exceptions – unchartered terrain (Bara 2020).

The question of how accurate the intelligence services of the United States assessed the global spread of nuclear weapons during the Cold War is the topic of *Jonas Schneider*. This is another case in which uncertainty abounds, because of the pervasive secrecy of the weapons programmes, the dual-use character of the technology and the associated politics of ambivalence, and the absence of a robust theory of why states build or do not build nuclear weapons. US intelligence services tended to overestimate nuclear proliferation, although their estimates – reassessed against today's state of knowledge – varied over time. The main reason for nuclear alarmism reflected how the agencies dealt with uncertainty: Lacking information about potential proliferators' intent and, more generally, about domestic and international demand-side factors, they placed too much emphasis on the technical capability of a state to build the bomb and on overall supply-side trends. While the intelligence analysts were aware of the perils of predicting other states' behaviour under uncertainty, policy-makers wanted clear instead of qualifying language. Paradoxically, the pessimistic forecasts played a crucial role during the 1960s in legitimizing a shift of US policy from nuclear sharing to nuclear nonproliferation, thereby shaping a new global nuclear order at the very time that at the bureaucratic level the intelligence estimates were the least alarmist (Schneider 2020).

Finally, *Matthias Leese* examines how predictive policing makes criminal futures visible and renders them actionable in practice. The industry that develops the software projects a vision of the future in which the algorithmic exploitation of data allows near-real-time decision-making, culminating in the promise to catch a criminal before the crime. Yet in practice, the software needs to be integrated in institutional structures and organizational routines that restrict the theoretical flexibility of situational analysis via limits in terms of planning and dispatching capacity. Updating the system once per day fits the institutional and operational context of existing policy work in Switzerland and Germany, although it only partially fulfils the managerial aspiration of increased efficiency and effectiveness of a reorganized police work. Predictive policing, Leese argues, is not just a technology, but a socio-technical assemblage. The growing computing power and the further algorithmic exploitation of data has the potential to fundamentally transform the relationship the police has with the future. Different societies and political systems will make different use of this emerging opportunity to address the future on an unprecedented scale and speed (Leese 2020).

As summarized and discussed in the conclusion, this book is not so much about the 'rights' and 'wrongs' or the precision of future projections, but about

inquiring into the politics of anticipating and predicting the future: The contributors to this book seek to understand why futures are sometimes contested while in other instances seem to be almost certain; why one particular account of the future eventually prevails while others fail; who has the power and expertise to preview the future, and whose voices are marginalized; how states and communities use their anticipatory knowledge for decision-making in the present and how they handle knowledge gaps and uncertainties; how the future co-constitutes, reflects back on and shapes the contemporary socio-political order; and what we can learn about how present beliefs, ideas and preferences shape assumptions about what is yet to come (Wenger *et al*. 2020).

References

Adam, B. (2008) 'Future Matters: Futures Known, Created and Minded', *Twenty-First Century Society* 3(2): 111–16.

Adam, B. (2010) 'History of the Future: Paradoxes and Challenges', *Rethinking History* 14(3): 361–78.

Agar, J. (2003) *The Government Machine: A Revolutionary History of the Computer*, Cambridge, MA: MIT Press.

Andersson, J. and Rindzevičiūtė, E. (2015a) 'Introduction: Toward a New History of the Future' in J. Andersson and E. Rindzevičiūtė (eds) *The Struggle for the Long-Term in Transnational Science and Politics: Forging the Future*, New York: Routledge, 1–15.

Andersson, J. and Rindzevičiūtė, E. (2015b) *The Struggle for the Long-Term in Transnational Science and Politics: Forging the Future*, New York: Routledge.

Aradau, C. (2014) 'The Promise of Security: Resilience, Surprise and Epistemic Politics', *Resilience* 2(2): 73–87.

Aradau, C. and van Munster, R. (2001) *Politics of Catastrophe: Genealogies of the Unknown*, London and New York: Routledge.

Aradau, C. and van Munster, R. (2007) 'Governing Terrorism through Risk: Taking Precautions, (Un)Knowing the Future', *European Journal of International Relations* 13(1): 89–115.

Assmann, A. (2013) 'Transformations of the Modern Time Regime', in C. Lorenz and B. Bevernage (eds) *Breaking up Time: Negotiating the Borders between Present, Past and Future*, Göttingen: Vandenhoeck and Ruprecht, 39–56.

Avey, P. C. and Desch, M. C. (2014) 'What Do Policymakers Want from Us? Results of a Survey of Current and Former Senior National Security Decision Makers', *International Studies Quarterly* 58(2): 227–46.

Bara, C. (2020) 'Forecasting Civil War and Political Violence', in A. Wenger, U. Jasper and M. Dunn Cavelty (eds) *Probing and Governing the Future: The Politics and Science of Prevision*, London and New York: Routledge, 117–93.

Beck, U. (1986) *Risikogesellschaft: Auf dem Weg in eine andere Moderne*, Frankfurt am Main: Suhrkamp.

Becker, F., Scheller, B. and Schneider, U. (eds) (2016) *Die Ungewissheit des Zukünftigen: Kontingenz in der Geschichte*, Frankfurt/New York: Campus.

Beckert, J. (2013) 'Imagined Futures: Fictional Expectations in the Economy', *Theory and Society* 42(3): 219–40.

Bell, D. (1964) 'Twelve Modes of Prediction: A Preliminary Sorting of Approaches in the Social Sciences', *Daedalus* 93: 845–80.

Berenskoetter, F. (2011) 'Reclaiming the Vision Thing: Constructivists as Students of the Future', *International Studies Quarterly* 55(3): 647–68.

Bernstein, S., Lebow, R. N., Stein, J. G. and Weber, S. (2000) 'God Gave Physics the Easy Problems: Adapting Social Science to an Unpredictable World', *European Journal of International Relations* 6(1): 43–76.

Blechman, B. M. (1998) 'International Peace and Security in the Twenty-First Century', in K. Booth (ed.) *Statecraft and Security in the Cold War and Beyond*, Cambridge: University Press, 289.

Bobrow, D. B. (1999) 'Prospecting the Future', *International Studies Review* 1(2): 1–10.

Brands, H. (2017) 'Why Scholars and Policymakers Disagree', *The American Interest*, 5 June, Online. Available: www.the-american-interest.com/2017/06/05/why-scholars-and-policymakers-disagree (accessed 17 July 2019).

Brown, N., Rappert, B. and Webster, A. (2000) 'Introducing Contested Futures: From Looking *into* the Future to Looking *at* the Future', in N. Brown, B. Rappert and A. Webster (eds) *Contested Futures: A Sociology of Prospective Techno-Science*, London and New York: Routledge, 3–20.

Bueno de Mesquita, B. (1998) 'The End of the Cold War: Predicting an Emergent Property', *Journal of Conflict Resolution* 42(2): 131–55.

Bueno de Mesquita, B. (2002) *Predicting Politics*, Columbus, OH: Ohio State University Press.

Bueno de Mesquita, B. (2010) *Predictioneer's Game: Using the Logic of Brazen Self-Interest to See and Shape the Future*, New York: Random House.

Byman, D. and Kroenig, M. (2016) 'Reaching beyond the Ivory Tower: A How To Manual', *Security Studies* 25(2): 289–319.

Choucri, N. (1978) 'Key Issues in International Relations Forecasting', in N. Choucri and T. W. Robinson (eds) *Forecasting in International Relations: Theory, Methods, Problems, Prospects*, San Francisco, CA: W. H. Freeman and Company, 3–22.

Choucri, N. and Robinson, T. W. (eds) (1978) *Forecasting in International Relations: Theory, Methods, Problems, Prospects*, San Francisco, CA: W. H. Freeman and Company.

Connelly, M. (2008) *Fatal Misconception: The Struggle to Control World Population*, Cambridge, MA: Belknap Press of Harvard University Press.

Connelly, M., Fay, M., Ferrini, G., Kaufman, M., Leonard, W., Monsky, H., Musto, R., Paine, T., Standish, N. and Walker, L. (2012) 'AHR Forum: General, I Have Fought Just as Many Nuclear Wars as You Have: Forecasts, Future Scenarios, and the Politics of Armageddon', *American Historical Review* 117(5): 1431–60.

De Goede, M. (2008) 'Beyond Risk: Premediation and the Post-9/11 Security Imagination', *Security Dialogue* 39(2–3): 155–76.

Desch, M. (2015) 'Technique Trumps Relevance: The Professionalization of Political Science and the Marginalization of Security Studies', *Perspectives on Politics* 13(2): 377–93.

Doran, C. F. (1999) 'Why Forecasts Fail: The Limits and Potential of Forecasting in International Relations and Economics', *International Studies Review* 1(2): 11–41.

Dunn Cavelty, M. (2020) 'From Predicting to Forecasting: Uncertainties, Scenarios and their (Un)Intended Side Effects', in A. Wenger, U. Jasper and M. Dunn Cavelty (eds) *Probing and Governing the Future: The Politics and Science of Prevision*, London and New York: Routledge, 89–103.

Dunn Cavelty, M. and Wenger, A. (2019) 'Cyber Security Meets Security Politics: Complex Technology, Fragmented Politics, and Networked Science', *Contemporary Security Policy* 41(1): 5–32.

Dunn Cavelty, M., Kaufmann, M. and Kristensen, K. S. (2015) 'Resilience and (In) Security: Practices, Subjects and Temporalities', *Security Dialogue* 46(1): 3–14.

Edwards, P. N. (1996) *The Closed World: Computers and the Politics of Discourse in Cold War America*, Cambridge, MA: MIT Press.

Feder, S. A. (2002) 'Forecasting for Policy Making in the Post-Cold War Period', *Annual Review of Political Science* 5(1): 111–25.

Fukuyama, F. (1992) *The End of History and the Last Man*, New York, NY: Free Press.

Gaddis, J. L. (1992) 'International Relations Theory and the End of the Cold War', *International Security* 17(3): 5–58.

Galison, P. (ed.) (1992) *Big Science: The Growth of Large-Scale Research*, Stanford, CA: Stanford University Press.

Gavin, F. J. (2008) 'History and Policy', *International Journal* 63: 162–77.

Gavin, F. J. (2020) 'Thinking Historically: A Guide for Policy', in A. Wenger, U. Jasper and M. Dunn Cavelty (eds) *Probing and Governing the Future: The Politics and Science of Prevision*, London and New York: Routledge, 73–88.

George, A. L. (1993) *Bridging the Gap: Theory and Practice in Foreign Policy*, Washington, DC: United States Institute of Peace Press.

Giddens, A. (1990) *The Consequences of Modernity*, Stanford, CA: Stanford University Press.

Grunwald, A. (2008) *Technik und Politikberatung*, Frankfurt am Main: Suhrkamp.

Habermas, J. (1968) *Technik und Wissenschaft als Ideologie*, Frankfurt am Main: Suhrkamp.

Hacking, I. (1990) *The Taming of Chance*, Cambridge: Cambridge University Press.

Helbling, D., Frey, B. S., Gigerenzer, G., Hafen, E., Hagner, M., Hofstetter, Y., van den Hoven, J., Zicari, R. V. and Zwitter, A. (2019) 'Will Democracy Survive Big Data and Artificial Intelligence?', in D. Helbling (ed.) *Towards Digital Enlightenment*, Cham: Springer, 73–89.

Held, D. (1995a) 'Cosmopolitan Democracy and the Global Order: Reflections on the 200th Anniversary of Kant's "Perpetual Peace" ', *Alternatives* 20(4): 415–29.

Held, D. (1995b) *Democracy and the Global Order: From the Modern State to Cosmopolitan Governance*, Stanford, CA: Stanford University Press.

Hellmann, G. (2020) 'How to Know the Future – and the Past (and How Not): A Pragmatist Perspective on Foresight and Hindsight', in A. Wenger, U. Jasper and M. Dunn Cavelty (eds) *Probing and Governing the Future: The Politics and Science of Prevision*, London and New York: Routledge, 45–62.

Henne, S., Kampmann, C., Marciniak, A. and Meteling, W. (2018) 'Security Turns Its Eye Exclusively to the Future: Zum Verhältnis von Sicherheit und Zukunft in der Geschichte', in C. Kampmann, A. Marciniak and W. Meteling (eds) *Security Turns Its Eye Exclusively to the Future: Zum Verhältnis von Sicherheit und Zukunft in der Geschichte*, Baden-Baden: Nomos, 9–36.

Hofstetter, J. and Lieberherr, B. (2019) 'Die digitale Transformation der Friedensförderung', in A. Wenger (ed.) *Bulletin zur schweizerischen Sicherheitspolitik*, Zurich: Center for Security Studies (CSS), 75–100.

Holloway, D. (1999) 'Physics, the State, and Civil Society in the Soviet Union', *Historical Studies in the Physical and Biological Sciences* 30(1): 173–92.

Hölscher, L. (2016) 'Heute war damals keine Zukunft: Dimensionen einer historischen Zukunftsforschung im 20. Jahrhundert', in F. Becker, B. Scheller and U. Schneider (eds) *Die Ungewissheit des Zukünftigen: Kontingenz in der Geschichte*, Frankfurt/New York: Campus, 79.

Horowitz, M. (2020) 'Future Thinking and Cognitive Distortions: Key Questions that Guide Forecasting Processes', in A. Wenger, U. Jasper and M. Dunn Cavelty (eds) *Probing and Governing the Future: The Politics and Science of Prevision*, London and New York: Routledge, 63–72.

Jäger, K. (2016) 'Not a New Gold Standard: Even Big Data Cannot Predict the Future', *Critical Review* 28(3–4): 335–55.

Jasanoff, S. (1994) *The Fifth Branch: Science Advisers as Policymakers*, London and Cambridge, MA: Harvard University Press.

Jasanoff, S. (2020) 'Imagined Worlds: The Politics of Future-Making in the Twenty-First Century', in A. Wenger, U. Jasper and M. Dunn Cavelty (eds) *Probing and Governing the Future: The Politics and Science of Prevision*, London and New York: Routledge, 27–44.

Jasanoff, S. and Kim, S.-H. (eds) (2015) *Dreamscapes of Modernity: Sociotechnical Imaginaries and the Fabrication of Power*, Chicago, IL: University of Chicago Press.

Jasper, U. (2020) 'The Anticipative Medicalization of Life: Governing Future Risk and Uncertainty in (Global) Health', in A. Wenger, U. Jasper and M. Dunn Cavelty (eds) *Probing and Governing the Future: The Politics and Science of Prevision*, London and New York: Routledge, 122–40.

Jordheim, H. (2012) 'Against Periodization: Koselleck's Theory of Multiple Temporalities', *History and Theory* 51(2): 151–71.

Katzenstein, P. J. and Nelson, S. C. (2020) 'Crisis, What Crisis? Uncertainty, Risk, and Financial Markets', in A. Wenger, U. Jasper and M. Dunn Cavelty (eds) *Probing and Governing the Future: The Politics and Science of Prevision*, London and New York: Routledge, 141–57.

Kessler, O. (2008) *Die Internationale Politische Ökonomie des Risikos: Eine Analyse am Beispiel der Diskussion um die Reformierung der Finanzmärkte*, Wiesbaden: VS Verlag für Sozialwissenschaften.

Kitchin, R. (2014) 'Big Data, New Epistemologies and Paradigm Shifts', *Big Data and Society* 1(1): 1–12.

Konrad, K., Van Lente, H., Groves, C. and Selin, C. (2017) 'Performing and Governing the Future in Science and Technology', in U. Felt, R. Fouché, C. A. Miller and L. Smith-Doerr (eds) *The Handbook of Science and Technology Studies*, Cambridge, MA: MIT Press, 465–94.

Koselleck, R. (1989) *Vergangene Zukunft: Zur Semantik geschichtlicher Zeiten*, Frankfurt am Main: Suhrkamp.

Koselleck, R. (1990) 'Wie neu ist die Neuzeit?', *Historische Zeitschrift* 251(1): 539–53.

Kristof, N. (2014) 'Professors, We Need You!', *New York Times*, 15 February. Online. Available: www.nytimes.com/2014/02/16/opinion/sunday/kristof-professors-we-need-you.html (accessed 17 July 2019).

Landwehr, A. (2018) 'Zukunft – Sicherheit – Moderne: Betrachtungen zu einem unklaren Verhältnis', in C. Kampmann, A. Marciniak and W. Meteling (eds) *Security Turns Its Eye Exclusively to the Future: Zum Verhältnis von Sicherheit und Zukunft in der Geschichte*, Baden-Baden: Nomos, 37–56.

Leese, M. (2020) ' "We Do That Once per Day": Cyclical Futures and Institutional Ponderousness in Predictive Policing', in A. Wenger, U. Jasper and M. Dunn Cavelty (eds) *Probing and Governing the Future: The Politics and Science of Prevision*, London and New York: Routledge, 213–25.

Lemos, M. C. and Klenk, N. (2020) 'Uncertainty and Precariousness at the Policy–Science Interface: Three Cases of Climate-Driven Adaptation', in A. Wenger,

U. Jasper and M. Dunn Cavelty (eds) *Probing and Governing the Future: The Politics and Science of Prevision*, London and New York: Routledge, 107–21.

Lentzos, F., Gouyon, J.-B., and Balmer, B. (2020) 'Imagining Future Biothreats: The Role of Popular Culture', in A. Wenger, U. Jasper and M. Dunn Cavelty (eds) *Probing and Governing the Future: The Politics and Science of Prevision*, London and New York: Routledge, 158–76.

Maasen, S. and Weingart, P. (2005) 'What's New in Scientific Advice to Politics? Introductory Essay', in S. Maasen and P. Weingart (eds) *Democratization of Expertise? Exploring Novel Forms of Scientific Advice in Political Decision-Making*, Dordrecht: Springer, 1–19.

Mellers, B., Stone, E., Atanasov, P., Rohrbaugh, N., Metz, S. E., Ungar, L., Bishop, M. M., Horowitz, M., Merkle, E. and Tetlock, P. (2015) 'The Psychology of Intelligence Analysis: Drivers of Prediction Accuracy in World Politics', *Journal of Experimental Psychology: Applied* 21(1): 1.

Meyer, C. O. (2011) 'The Purpose and Pitfalls of Constructivist Forecasting: Insights from Strategic Culture Research for the European Union's Evolution as a Military Power', *International Studies Quarterly* 55(3): 669–90.

Michael, M. (2017) 'Enacting Big Futures, Little Futures: Toward an Ecology of Futures', *The Sociological Review* 65(3): 509–24.

Montgomery, A. H. (2016) 'Quantum Mechanisms: Expanding the Boundaries of Power, Space, and Time in Global Security Studies', *Journal of Global Security Studies* 1(1): 102–6.

Montgomery, A. H. and Mount, A. (2014) 'Misestimation: Explaining US Failures to Predict Nuclear Weapons Programs', *Intelligence and National Security* 29(3): 357–86.

Montgomery, A. H. and Sagan, S. D. (2009) 'The Perils of Predicting Proliferation', *Journal of Conflict Resolution* 53(2): 302–28.

Nelson, S. C. and Katzenstein, P. J. (2014) 'Uncertainty, Risk, and the Financial Crisis of 2008', *International Organization* 68(2): 361–92.

Nelson, N., Geltzer, A. and Hilgartner, S. (2008) 'Introduction: The Anticipatory State: Making Policy-Relevant Knowledge about the Future', *Science and Public Policy* 35(8): 546–50.

Neumann, I. B. and Øverland, E. F. (2004) 'International Relations and Policy Planning: The Method of Perspectivist Scenario Building', *International Studies Perspectives* 5(3): 258–77.

Nowotny, H. (2018) *Time: The Modern and Postmodern Experience*, Cambridge: Polity Press.

Radkau, J. (2017) *Geschichte der Zukunft: Prognosen, Visionen, Irrungen in Deutschland von 1945 bis heute*, München: Carl Hanser Verlag.

Reynolds, D. (2010) 'Science, Technology, and the Cold War', in M. P. Leffler and O. A. Westad (eds) *The Cambridge History of the Cold War*, Cambridge: Cambridge University Press, 378–99.

Rossiter, M. W. (1985) 'Science and Public Policy since World War II', *Osiris* 1: 273–94.

Schelsky, H. (1970) 'Thoughts on Sociological Planning', *Law and State* 2: 102–15.

Schneider, J. (2020) 'Predicting Nuclear Weapons Proliferation', in A. Wenger, U. Jasper and M. Dunn Cavelty (eds) *Probing and Governing the Future: The Politics and Science of Prevision*, London and New York: Routledge, 194–212.

Seefried, E. (2013) 'Steering the Future: The Emergence of "Western" Futures Research and Its Production of Expertise, 1950s to early 1970s', *European Journal of Futures Research* 2(1): 1–12.

Seefried, E. (2015) *Zukünfte: Aufstieg und Krise der Zukunftsforschung 1945–1980*, Berlin: De Gruyter Oldenbourg.

Solovey, M. (2001) 'Introduction: Science and the State during the Cold War: Blurred Boundaries and a Contested Legacy', *Social Studies of Science* 31(2): 165–70.

Taleb, N. N. (2009) *The Black Swan*, London: Random House.

Tetlock, P. E. and Gardner, D. (2016) *Superforecasting: The Art and Science of Prediction*, New York: Random House.

Van Laak, D. (2008) 'Planung: Geschichte und Gegenwart des Vorgriffs auf die Zukunft', *Geschichte und Gesellschaft* 34(3): 305–26.

Ward, M. D. (2016) 'Can We Predict Politics? Toward What End?', *Journal of Global Security Studies* 1(1): 80–91.

Ward, M. D., Greenhill, B. D. and Bakke, K. M. (2010) 'The Perils of Policy by P-Value: Predicting Civil Conflicts', *Journal of Peace Research* 47(4): 363–75.

Ward, M. D., Metternich, N. W., Dorff, C. L., Gallop, M., Hollenbach, F. M., Schultz, A. and Weschle, S. (2013) 'Learning from the Past and Stepping into the Future: Toward a New Generation of Conflict Prediction', *International Studies Review* 15(4): 473–90.

Wenger, A., Jasper, U. and Dunn Cavelty, M. (2020) 'The Politics and Science of the Future: Assembling Future Knowledge and Integrating It into Public Policy and Governance', in A. Wenger, U. Jasper and M. Dunn Cavelty (eds) *Probing and Governing the Future: The Politics and Science of Prevision*, London and New York: Routledge, 229–50.

Zambernardi, L. (2016) 'Politics Is Too Important to Be Left to Political Scientists: A Critique of the Theory-Policy Nexus in International Relations', *European Journal of International Relations* 22(1): 3–23.

Part II

Academic perspectives on future-oriented policy-making

2 Imagined worlds

The politics of future-making in the twenty-first century

Sheila Jasanoff

The rise of science and technology as major forces in world-making upset three widely held assumptions about the foundations of politics: its materiality, its presentism, and its localism. Politics was traditionally thought to be a struggle over the conditions of everyday life in the present (Thompson 2010), a zero-sum game in which benefits to some arrive inevitably at cost to others. Conventional politics plays out, on this view, over the allocation and distribution of a bounded set of goods in a temporally and spatially contained world, among groups competing for their proverbial 'share of the pie'. That pie is a package of benefits and burdens whose dimensions at any given moment are imagined as expressly known and calculable, and hence divisible among competing interests in ways that a polity can both see and understand. A simple example of this politics of instant gratification is the tax cut. One can observe almost instantly in a given year's tax returns who won and who lost vis-à-vis the prior year, and whether promises were kept or not.[1] Outcomes of such politics, the testable politics of the here and now, are conceived as immediate, tangible, and available for popular evaluation and judgement. They most easily achieve what the political scientist Fritz Scharpf termed 'output legitimacy', or validation by results (Scharpf 1997).

Another adage holds that 'all politics is local'. Political struggle, on this view, occurs not only in real time for shares of limited resources but also within a well-demarcated social environment: whether a relatively small one like a family, a school district or a municipality, or a much larger one like a nation state or, at the outer limit, the entire global community and even future generations. Issues closer to home typically offer both what Scharpf termed 'input legitimacy', an accepted process for aggregating preferences, and 'output legitimacy' in the form of visible results. Thus, mayors in northern American cities are routinely held accountable for failures of snow removal. One analyst of municipal politics remarked, only partly tongue in cheek: 'But woe betide the big-city mayor who fumbles the fundamental test of municipal governance: snow ploughing. For that, there will be no forgiveness' (Dudley 2017). On a less mundane scale, in American politics, Hubert Humphrey may have lost the 1968 presidential election to Richard Nixon because of televised riots and a perceived breakdown of law and order in Chicago. The failure of

George W. Bush's administration to cope with the aftermath of Hurricane Katrina in New Orleans may well have cost the Republican Party more votes in 2008 than the ill-fated Iraq war or that election year's fateful financial meltdown.

The space bounded by presentism and localism is where ideology historically took root, finding systematic grounds to favour one set of interests over another – whether for reasons of class identification, or a promised ability to make economies grow, or to defend transcendental values such as equality and social justice. Some struggles came to be seen as foundational enough to define politics, such as labour versus capital, privatization versus state control, independence versus colonial domination, and rights of disadvantaged groups versus majority entitlements. Sharp battle lines along these axes, dividing a canonical progressive left from an equally canonical reactionary right, presupposed that the salient factors determining political choice are known, or in principle knowable to all relevant actors: such as the nature of one's identity, economic position, and class interests.

The quintessential locus of democratic politics, on the classical account, is the polling place or voting booth. This is where the citizens of a *polis*, those formally entitled to participate in the political process, record their preferences, elect representatives, and authorize actions that the majority desires. Elections are occasions where having a political voice counts and political belonging can be performed. Hence, too, the recurrent great movements of emancipation, especially over the long twentieth century, to bring historically excluded groups into the ranks of voting citizens, as acknowledged members of a political community. Persistent denial of such representation has lit the fuse for revolutionary protests the world over, whether in the United States in 1775, 1861, or 1920, France in 1789, India in 1930, or Hong Kong in 2019.[2]

In contemporary politics, the street and the polling place serve as complementary vessels for channelling the same basic demand for voice and recognition. Both accommodate great outpourings of popular sentiment to express how people wish to be governed with respect to their matters of concern. But whereas the voting booth is open to every recognized member of a democratic polity, the street attracts those upstarts and renegades who feel they do not yet have a voice in their community's official forms of politics. One thrives on routinized process and an established past; the other on imagination and promises, and a future still in the making. One represents the taming of democracy, the other its unchained force (Hardt and Negri 2000).

Now, as the late twentieth century yields to the twenty-first, rents in our traditional understanding of politics have become apparent. First, political theory has tended to ignore a fundamental question about what makes people feel (or not feel) part of a given polity, that is, the nature of subjectivity and belonging that are constitutive of political identities and movements. What is it about political membership – not merely an imposed, top-down nationalism (Anderson 2006[1983]) – that means something to people, enough to make them go out and vote or to campaign for representation? Voting behaviour is especially puzzling.

It is only in relatively authoritarian nations, or where compulsory voting is enforced, that a high percentage of the electorate turns to the ballot box. Elsewhere, apathy is more often the rule, and local elections where issues are presumably closest to home often draw the lowest levels of participation. Voting, in short, seems a high-level political desideratum exactly where one does not have it as a right, but at best an ambiguous good in societies where the right is freely given.[3] This suggests that, even prior to the politics of exercising voice (Hirschman 1970), there must be a politics of identity-making, coupled with a sense of purpose and engagement – a judgement that there is something important to come together and vote *for* – that has received too little attention from analysts of the politics of the present.

Further, the issues and concerns that mobilize people in contemporary societies seem often to have little to do with grand questions of right or left ideology. Since the political shocks of 2016 – Britain's withdrawal from the European Union, the election of US president Donald J. Trump, and the rise of disaffected populist parties throughout Europe and beyond – commentators have wondered why people vote against their long-term class or economic interests. Some have blamed the rise of a post-truth culture and a loss of trust in expertise for the surge of populism (d'Ancona 2017). Others point to the disconcerting gap between rhetoric and realization. Disappointed expectations of immediate gratification and local order seem to mobilize political responses more effectively than abstract claims about liberty or human rights or even progress. If there is one dominant ideology that cuts across large swaths of the globe in this century, it is a return to nativism, a rebellion against all of the mid-century institutions built to ensure global peace, prosperity, and well-being. The practices of early twenty-first century politics seem in this respect to belie the confident predictions of both economic expertise and grand theories such as world systems analysis (Wallerstein 2004). If transnational collectives are forming today, it is not around ideas of economic growth or the global common good; if anything, such movements may be driven more by fear than by optimism.

Perhaps most significantly, the zero-sum model of politics and redistribution takes little account of the role of science and technology in creating new horizons of benefit and risk. Scientific discoveries and their applications have opened up the future as a space of political struggle in countless ways. From the lure of increasing automation, powered by immense computing capability, to the eradication of unwanted life forms, genetic disease, and even aging, science and technology offer promises of futures that seem worth fighting for, or possibly against, depending on actors' visions of what makes societies good and desirable (Jasanoff and Kim 2015). Technology, moreover, is a harbinger of extreme and catastrophic visions as well as progressive ones. An era marked by threats of nuclear and climate annihilation, and the imminent takeover of the human workforce by machines, has altered the stakes of global politics and created new political alliances, bypassing or even excluding the state actors who previously dominated the international stage.

Indeed, contestation over possible technoscientifically driven futures turns several key assumptions of traditional interest-group politics on their head. In the futuristic world, the pie of benefits is not necessarily limited in size, because goods such as a cure for cancer will theoretically be available to all humanity, just as threats of extreme disasters afflict us all (Beck 1992[1986]). Further, matters in deep contestation, such as the impacts of climate change or increasing automation, are not only of concern to present generations; nor, in the digital era, are sites of struggle necessarily bounded by the territorial borders of particular geopolitical entities, such as a city, region, or nation. More importantly, the speculative character of prediction breaks apart the relatively simple synergy between knowing and acting that powered classical political mobilization. The consequences and questions for politics are profound.

As if in a Jenga game, the familiar supports for shaping and theorizing politics have been pulled out one by one in the politics of future-making, leaving analysts to question whether long-established political forms, even democracy itself, are any longer viable in the spatial and temporal orders of prediction. In the dim, partially discernible spaces of what is to come, what takes the place of mundane, visible, real-world outputs, such as taxes or potholes or snow removal? If the benefits and burdens to be allocated through struggle lie in the realm of speculation, then how do people gain enough confidence to act on such predictions? And who in any case are 'the people'? Without a recognizable *polis* to respond to impending global crises, how can there be a well-defined polity to engage meaningfully in political action?

These unsettling aspects of predictive politics are the subject of this volume. The book as a whole seeks to understand how science and politics interact to create spaces of political involvement that lack the familiar markers of certainty about the purposes and means of struggle, and yet are replete with issues of entitlement and allocation that are the very stuff of politics. These are spaces in which imagination becomes a potent resource, since persuading people to opt for any vision of a future world, *the things to come* as the introduction puts it, requires a leap into a fictive, unrealized landscape of dreams rather than one of tangible reality. At the same time, those visions must have enough solidity to win people's allegiance, to enable action, and secure buy-in. In this chapter, using analytic resources from the field of science and technology studies (STS), I look at three sites in which the dynamics of predictive politics is playing out: making the objects of governance, making instruments of intervention, and making political subjects and polities. In each case, science, expertise, and material technologies function as agents of social and political mobilization, alongside and intertwined with traditional political institutions such as legislatures and regulatory agencies. Overall, I argue that the rise of prediction as a mode of governance has troubled existing practices of constitutional government, thrust new questions of trust and accountability into national and international debate, and set in train movements in political and social thought that amount, in effect, to a reconstitutionalizing of contemporary politics.

Socio-technical imaginaries: theorizing the future

Economic activity has long been modelled as the process of production, based on the Marxian factors of land, labour, and capital. Technological innovation and improvements can alter the relationships among those classic input variables, producing not only new constellations of economic power (or dispossession) but also changes in the social order as power moves from the haves to the have-nots, and vice versa. Thus, the transition from a coal- to an oil-based economy in the twentieth century brought large shifts in the socio-economic status of nations and regions, lifting once-poor countries like Norway and the Gulf States to the richest of rich, but also as Timothy Mitchell has argued, disrupting the place-based foundations of democratic politics (Mitchell 2011). With climate change putting fossil-fuelled futures in jeopardy, wind and sunshine along with the capacity to harness them emerged as new forms of wealth and power, supplementing decades-old efforts to enlist atoms for peace with nuclear technologies. All these developments still rest on the exploitation of land, labour, and capital, although the forms and modes of capitalization have shifted in politically dramatic ways.

That politics too can be viewed as a site of production, relying on a range of input variables, is less commonly discussed than are models of economic growth; and yet in the era of prediction the development of science and technology goes hand in hand with the capacity to produce new political imaginations. The two forms of productivity synergize, and the resulting dynamic is what STS scholars term 'co-production'. It is the play of giving shape simultaneously to a material world through technoscientific means and to political ideas of how societies should respond to the resulting order of things. In my introductory essay in *States of Knowledge*, I defined the term as follows: 'Co-production is shorthand for the proposition that the ways in which we know and represent the world (both nature and society) are inseparable from the ways in which we chose to live in it' (Jasanoff 2004: 2). Co-production can be observed at all possible scales of governance and in many processes of social construction, most especially in the making of representations, discourses, identities, and institutions – in short in the things to be governed, in the instruments that do the work of governing, and in the polities with stakes in the legitimacy of government.

Seeing technologies as instruments of political as well as material production complicates a familiar argument from the early days of science and technology studies, namely, in the words of political scientist Langdon Winner, that 'artifacts have politics' (Winner 1980). Winner suggested that the very design of technological systems, such as their relative opacity or transparency, aligns with particular forms of politics. A highly black-boxed and inscrutable technological system, such as nuclear power generation, lacks transparency, Winner argued, and thus deprives citizens of meaningful opportunities to take part in managing it. The same could be said of something as simple as a highway design that lets some vehicles freely get to some locations but inhibits other forms and routes of travel.[4] Technology's unchecked power over our lives, exercised through often

invisible design choices, is inconsistent with democracy's first principle: That members of a polity must have opportunities to penetrate the workings of power, demand explanations, and say yea or nay to the choices made by governing political institutions. Anything else would be plainly anti-democratic.

Winner's way of thinking about technology provided an easy conceptual bridge between two realms that political science had traditionally held apart, the technological (or in more contemporary language, the technoscientific) and the political. His succinct formulation insisted that technological design serves a political purpose because it enables some ways of doing things and disables others, and because those choices are not always plain to the *demos*. Still less are technological choices deliberated or granted popular assent. Yet the simplicity of Winner's analysis was also a problem, in that attributing 'politics' to 'artifacts' represented both worlds as more static and invariant than they are in practice. Politics, after all, comes in many flavours, as do technological systems, and both evolve and change through their interaction. Merely pointing out that the two are linked says nothing about how the one affects the other, nor why the same technological system elicits radically different forms of politics and governance in different cultural settings (Jasanoff and Kim 2009). To explain the diverse ways in which technological trajectories develop around the world, one needs a more nuanced theory, one grounded in a deep understanding of co-production and sensitive to the distinctive attributes of the politics of future-making. The concept of socio-technical imaginaries (STIs) offers such a framework.

As defined in *Dreamscapes of Modernity* (Jasanoff and Kim 2015: 4), STIs are 'collectively held, institutionally stabilized, and publicly performed visions of desirable futures, animated by shared understandings of forms of social life and social order attainable through, and supportive of, advances in science and technology'. This definition brings under one roof Benedict Anderson's famed idea of nationhood as a kind of 'imagined community' (Anderson 2006[1983]: 6) and the efforts of STS scholars such as me to show that collective political imaginations today cannot be separated from the futures promised by science and technology. It follows, too, that the contemporary orchestrators of collective visions are as much leaders of science and industry as minions of the state. Anderson identified the state and its captive print media as the primary agents of creating national fellow-feeling.[5] Adding science and technology to the mix decentres the state, as well as the media, although alliances between states and science remain, as ever, powerfully constitutive (see, for example, Edgerton 2011). Science, however, brings its own independent ideas of progress and salvation to the building of collective consciousness, and the resulting forms of self-understanding and self-identification are not necessarily congruent with the nationalisms of earlier centuries. Importantly, then, unlike prior work on imagined national communities, the STI framework attends to just the sorts of transformations that make the politics of the twenty-first century so different from the politics that went before, detaching it from tangible materiality, temporal immediacy, and spatial boundedness. These shifts have left their mark on the

definition of objects and instruments of governance, the composition of polities, and of course the age-old question of who rules.

Governable objects in the era of prediction

Possibly no single object now known to humankind has demonstrated quite such capacity to reshape politics as the global climate. In relatively short order, humanity's view of its appointed fate shifted from thoughts of nuclear annihilation (Weart 1988) to the spectre of civilization ending through a drastic rise in the Earth's mean surface temperature. Attempts to come to grips with the facts of climate change altered how we think about the weather forecast and our own consumption habits, has given rise to new institutions and discourses of management and control, empowered new cadres of experts, created markets, and fostered improbable alliances between and across industrial sectors and nations. Yet, for all its power to mobilize human action, the global climate remains a pure abstraction. Built out of decades, in some cases centuries, of observation of changes in the Earth's weather, soils, water, and vegetation, it is documented in countless data points and combined into a pervasive whole (Edwards 2010); yet it cannot be grasped in the hand like a loaf of bread, a tank of fuel, or a piece of paper bearing its monetary worth on its face. Nor can climate change be felt on the skin like the day's weather. In its immateriality, its placelessness, and its indeterminate impacts, the global climate is typical of the governable objects of future politics. But it is not the only such construct.

Long before climate rose to the forefront of global policy consciousness, there was the concept of risk. Threats to human well-being come in varying degrees of scope and significance: from *de minimis* or low-consequence ills, like a sprain from running or a fall from a ladder, to catastrophic and high-consequence events, such as a nuclear accident. The resulting harms can be acute or chronic, reversible or irreversible. All are subsumed under the concept of risk. Technically defined as the probability of harm times the magnitude of harm, risk evolved at one level as a mathematical concept, but for policy-makers it also spawned a discourse of legitimation, a way of rationalizing the exercise of power directed toward future ends. A landmark report of the US National Academy of Sciences recommended in 1983 that risk should be governed through a two-step process: assessment and management (NRC 1983). Risk assessment should be conducted largely on the basis of sound science, to determine the seriousness of the projected harm, whereas risk management should incorporate social values and weigh risks against benefits to arrive at appropriate policy responses (NRC 1983).

To the extent that risks befall members of societies, risk assessment belongs to the social sciences, and increasingly these are sciences of prediction. The rise of the quantitative social sciences from the mid-nineteenth century (Hacking 1990; Porter 1986) on through this century's developments in computer science, modelling and latterly data science made society's dynamics ever more tractable at temporal removes and scales of aggregation that pre-moderns could

not have imagined. What societies seek to govern, and how they govern it, were transformed. The aims and objects of governance morphed in size and scope, as well as in their temporal situation, from small and near-term problems – those potholes and snowy roads – to distant, geographically dispersed, and increasingly faraway futures.

To be sure, the ability to imagine problems beyond the immediate and the tangible was itself a form of co-production that evolved over centuries. From the beginnings of the Enlightenment, science has populated the human imagination with invisible objects that can nevertheless be made tractable through technological means, from the vacuum to the germ, the atom, and the gene. Edward Jenner and Louis Pasteur found ways to immunize people and animals against diseases carried by invisible infectious agents, and Pasteur developed a technique that rids milk of most of its deadly pathogens. Physicists probed the atom's internal structure, although it took the bomb and the nuclear reactor to make the atom's energy comprehensible. Penicillin and other antibiotics cured illness and prevented epidemics, while DDT and related chemicals tackled the animal vectors carrying lethal parasites. Faced with mounting evidence that unseen does not have to mean unmanageable, laws that once held people liable only for deterministic chains of causation[6] gradually enlarged the scope of responsibility to include what experts could reasonably have foreseen. In one notorious episode, an Italian court in L'Aquila convicted half a dozen seismologists and public officials for failing to give due warning of a deadly earthquake in 2009. Critics of the (eventually overturned) judgement complained that it was based on a fundamental misconception of how much certainty science could provide, but many believed that experts should have told people that a catastrophic threat could not be ruled out. Citizens, they argued, could then have taken reasonable precautions and survived.

Such shifts in problem framing, from imminent to futuristic, entailed corresponding changes in people's expectations of how governing authorities should couch their arguments and justify their actions. Mathematical reasoning became pervasive and was increasingly identified with objective judgement (Porter 1995; Deringer 2018). At the same time, this dispassionate way of constructing dependable social knowledge (Camic *et al*. 2011) demoted people's subjective experiences of the world, creating tensions between lives lived in the present and lives not yet in being, governed by sophisticated mathematical predictions reaching into remote futures. Not everything that the predictive sciences rendered as equivalent for risk management were felt as commensurable by people on the receiving end of power and policy. How does one weigh the death of one's child from a rare adverse drug reaction against public health benefits for society as a whole (Calabresi and Bobbitt 1978), or the sacrifice of an indigenous nation's sacred lands against the benefits of cheap electricity for people to whom that land has no meaning (Espeland 1998)? Monetization added its own layers of uncertainty and conflict, as planners came to realize that cash in the hand now is worth more to most people than cash 10 or 20 years hence. Economists developed practices of discounting to decide what value to place in

the present on future expectations, thereby bringing within the scope of governance matters that had previously lodged outside the bounds of imagined human control (Beckert and Bronk 2018).

What, then, are the implications for politics, as immediacy recedes and governments engage more in remote threat management, possibly tilting at windmills, than in the delivery of tangible welfare benefits? One could point to the rise of sceptical populisms and newly reimagined nationalisms as a partial worldwide reaction to the detached futurism of the predictive natural and social sciences. The grand climate debates are the most prominent site where the battle lines are clearly drawn, with scientists, liberals, and rich-country youth joining hands on one side and reactionary politicians and their allies in the fossil fuel industry on the other. Each is invested in an existential future whose loss seems unthinkable, but the futures themselves are radically incompatible articulations of different worlds that combine the material and the moral substrates of life in ways that do not mesh. Sweden's Greta Thunberg spoke as if inspiring a latter day Children's Crusade when she stood before the United Nations General Assembly in 2019 and exhorted her elders to give back to her generation a future that seemed to be slipping away: 'I should be back in school on the other side of the ocean. Yet you all come to us young people for hope. How dare you. You have stolen my dreams and my childhood with your empty words.'[7] Her example energized marches around the world and weekly convocations of young people convening under the banner of 'Fridays for Future', a future so seemingly cataclysmic as to rob children of their expected agency. Even education, the classic gateway to flexible futures, seemed useless to these crusading youngsters unless the climate crisis, as science predicts it, is brought under rapid control.

Yet, in the United States, the biggest source of greenhouse gas emissions, Republicans angrily dismissed Thunberg's message, while Donald Trump continued his tirades on behalf of an alternate reality, one in which climate change is a conspiracy and coal remains a clean and beautiful source of power. On this basis, Trump fought for industries that would have to shut down if Thunberg's exhortations were enacted into policy, leaving their employees, among the president's most reliable supporters, without a working future. In mining country, the prospect of closing the mines leaves already depressed economic zones without much promise of life beyond. Alternative pathways would require massive investments, even thinking anew the landscape itself. In the fracking, mining, and refining heartlands of the United States, no-one has yet conceived the sort of vast, yet incremental, geoengineering projects that Germany undertook to convert the old strip mines of former East Germany into new lake districts for well-to-do vacationers and leisure-seekers from the West (Gross 2010).

Climate change, as we have already noted, is only the most prominent among a host of predicted objects that offer new handholds for governance at supranational scales. Whether wrapped in the bureaucratic language of sustainable development goals or focused on outbreaks and manifestations such as international terrorism, the spectre of pandemics, or a 'Day Zero' of no water

in Chennai or Capetown, the future of human societies on Earth seems bound up with scenarios and outcomes that resist management according to the old rules. The future calls for new instruments of control, commensurate with its decentred, immaterial, and shape-shifting concerns. How has that call been answered?

Intervention on a planetary scale

To contain a problem, one can tackle it at either end, root out the causes or contain the effects. The politics of the future encompasses both forms of action, but techniques diverge depending on whether the focal problem is seen principally as one of human behaviour or one that primarily implicates physical and biological systems. Correspondingly, the emerging instruments of governance can be roughly divided between those that seek to modify how people act and those that seek to control the impacts of harmful collective action. The former have more to do with our imagination of origins, the latter more with consequences. Either way, the rising preoccupation with futures has dragged the policy world toward a new age of engineered solutions, though opinions differ as to whether the objects most in need of engineering are human actors and their behaviours or the biogeochemical systems within which the species so abundantly, and consequentially, proliferates.

Social theorists of the twentieth century were fearful of technology displacing human agency and crippling our capacity to act – a concern memorably foreshadowed in Max Weber's vision of 'machine production' that determines the lives of those born into the 'tremendous cosmos of the modern economic order' and imprisons them in an 'iron cage' (Weber 1930[1905]). The worries of our era seem fixated more on the imperfect human drivers of the economic order. The concern is that humans, left to their own devices, are cognitively flawed and will act as agents of *un*-reason, whether through ignorance or, more dangerously, through biases built into the human brain (Tversky and Kahneman 1974; Kahneman 2011). This 'finding' of collective irrationality has given the impetus to engineering solutions that attempt to fix the future by fixing ourselves as agents of its creation. Its most powerful technique is the nudge (Thaler and Sunstein 2008), a set of devices with which the presumed rational ruler can impel people to override their biased minds and make defensible choices. The policy-maker's job, then, is to make sure that people frame and make the right decisions in situations where their unguided instincts might lead them astray. Policy, especially economic policy, becomes in part an architectural project whose function is to design environments that promote reasoned choice-making.

Philosophical discussions of nudging have tended to focus on whether such top-down steering of human subjects preserves essential values of autonomy and dignity (Waldron 2014; Johnson 2016; Sunstein 2016), but these analyses leave unexplored the fluidity of intersubjective knowledge and its role in shaping the very terms of moral reckoning. What, after all, does autonomy mean in a world

that, since Weber's time, has bound people to machines in ever more intricate networks of dependence, and now threatens to blur the distinction between human and machine intelligence? And what, in any case, gives ruling elites the authority to know what is right or rational for the masses? The felt paternalism of nudging – a factor that its advocates mitigate by calling it *libertarian* paternalism – takes on further overtones of hubris when politics becomes predictive. For in the world of prediction, the outputs that guarantee a form of legitimacy to the politics of the present are no longer discernible. Gains and losses are removed to the sphere of promises, and their validity may rest more on ideology than visible evidence (Beckert 2019). Like sustainability or a stable climate, the fruits of predictive policy are neither accessible to those living in the present nor even attributable with any certainty to particular courses of action or inaction. The legitimacy of such promises rarely flows from the statements of experts alone, statements that in any case are loaded with the values of their time and place. Rather, legitimacy depends crucially on whether the promises appeal to collective imaginations that are already embedded in STIs circulating in society, such as the myth of the conquerable frontier in US politics or, more recently, the simple promise to 'make America great again'.

At first glance, attempts to make the future tractable to policy through technology seems to avoid the pitfalls of reengineering humans according to some putatively ahistorical and translocal model of rational behaviour. When mechanical tools are enrolled into risk avoidance or harm mitigation, the solution seems geared toward producing the kinds of outputs that people can easily evaluate and whose effects can therefore be judged in accordance with socially accepted criteria of goodness. Yet, in the predictive world, the efficacy of the technological fix bumps up against the same constraints of imperfect vision and ideological predisposition that render nudging so deeply suspect. Thus, geoengineering through solar radiation management, the most ambitious of imagined remedies for climate change (Keith 2013), derives from Cold War superpower imaginaries of cloud seeding and weather modification. It promises to keep today's leaders in technology and capital, and their epistemic and moral biases (Rayner 2013), in the driver's seat when assessing the nature and gravity of harm. Needless to add, technological fixes conceived on such grand scales are premised on tacit understandings of who has the right to frame and solve problems. They do little or nothing to redress the histories of inequality and injustice that gave rise to many global social ills in the first place.

Cutting across instrumental visions of how to manage the future, whether by manipulating human behaviour or by mitigating foreseeable harm, is the perennial question for democracy: with whose assent? Political philosophy has wrestled with the problems of representing future generations and groups that are not represented by nation states or other well-defined political unions (Thompson 2010). The added dimension that STS brings to the picture is the co-productionist insight that modes of intervention and modes of self-awareness are interdependent. Subjective senses of belonging to a polity are conditioned, in other words, by the very modes of representing and intervening

that presuppose a preexisting community. Predictive politics thus has to continually interrogate how the devices used in governance interact with modes of identity-making, lest seemingly neutral, objective instruments such as nudging fashion and legitimate the worlds they presume merely to discover and regulate. The tie-ins between instruments of governance and the constitution of political subjects forms the final section of this chapter.

Predictive politics and governable subjects

Regulatory devices, whether social or material, are designed with tacit, if culturally grounded, understandings of how human beings reason and behave. Otherwise, such devices could not easily be implemented or achieve the desired results. Built into any regulatory system, therefore, is a model of the reasoning individual and a theory of collective action, as well as technical ideas of how things function in the material world. So, nudge theory rests on psychological claims about how the human mind works when confronted with choices, as well as on social agreements that 'problems' such as inadequate saving or excessive eating should be alleviated. Similarly, advocacy for solar geoengineering assumes that natural cooling observed from volcanic eruptions can be replicated with artificial injection of aerosols into the Earth's atmosphere. It also presumes that, confronted with the dire consequences of climate change, people will favour engineering the atmosphere as the lesser of two evils.

These ways of imagining natural and social expectations together illustrate the dynamics of co-production in future-making, but they do more. Regulatory regimes in effect impose on social life what Michel Foucault termed 'the order of things' – an epistemic and normative framework of control in which human subjects behave as the world seems to demand of them (Foucault 1970[1966]). In this sense, regulatory policy is a socio-technical imaginary that projects onto society desired futures toward which people are expected to direct their actions. Thus, a speed limit presupposes that people will not drive much faster than the sign says, a tax code takes for granted that most people will pay their financial dues, an environmental standard defines what people will regard as a safe industrial practice, and an anti-terrorism law expects that some, at least, will be deterred from extreme violence, knowing that massive penalties await them. Collective reason and even felt agency and subjectivity, in short, do not preexist the imagined order of the future. They are constituted and performed in the implementation of the imaginary.

For social scientists steeped in liberal thought the market has served as one powerful regulatory imaginary, indeed since the later twentieth century as the dominant one. It is the cornerstone of the architecture of choice. The (perfect) market is conceived as the ultimate unconstrained space in which people freely barter and make exchanges, ensuring that maximum collective well-being is secured at least cost and least constraint. Incentivizing rational, competitive behaviour by private entities is seen as the antidote to state failure. Markets, it is believed, unleash human energy in the search for better solutions, instead of

tamping down initiative through ill-conceived overreaching by poorly informed and resourced states. The alleged defeat of socialism in the late twentieth century offered ultimate vindication of these beliefs. Not surprisingly, then, market incentives have been proposed for managing some of the world's most intransigent future problems, carbon markets for controlling greenhouse gases being only the most prominent.

If, however, we see the market as a socio-technical imaginary rather than as a tool for regulating collective behaviour, the work needed to make markets function becomes more analytically salient. It is well known from the STS literature that the very idea of establishing an exchange system requires acts of commensuration that raise all the problems of judgement and reduction associated with government by numbers. To make markets work, one must establish which things can be exchanged for which other things. This is far from straightforward even when trades involve basic commodities such as clothing or food stuffs, but the difficulties mount exponentially when previously non-tradeable, physically disparate entities such as greenhouse gases are turned into goods to be exchanged (MacKenzie 2009). Commodities, moreover, must be standardized and rendered transparent for counts and audits in order to enable trust in a market – again, no easy task (Power 1997).

More importantly, however, making markets blurs the distinction between economics and politics and between consumers and citizens. Establishing an exchange system by making tradeable commodities serves at one and the same time as an exercise in controlling the status of political subjects. To the extent that market-making involves the production of things of value, it also involves a reshaping of what people want, and by extension the will of the subjects holding those preferences. Thus, it has become a truism to say that millennials who grew up in the digital era have a different sense of privacy from their elders, because they think nothing of sharing deeply personal information and images with tens and hundreds of others (Turkle 1995). Many indeed give up their personal data cheerfully because they welcome targeting by private goods and service providers whom they might not have encountered but for the infinitely webbed connections of the internet. In the biological realm, the development of genetic engineering and genome editing not only gave rise to a socio-technical imaginary of life liberated from inherited disease, but it also changed our understanding of conditions that human beings may rightfully wish not to be born with – today genetic disease, but tomorrow possibly short stature, dark skin, lower IQ, or depressive tendencies. It also changed politics. Human perfectibility may have been an aspiration since humans learned to envision a future, but in the domain of prediction it becomes part of a promissory package that governments can offer to win votes and sway opinion.[8]

The logic of the market demands, as well, a redrawing of the boundary between private and public. Sometimes that line is explicitly moved by law or regulation, as when a government decides to privatize what was a state obligation, such as a railway or a water supply, or in reverse to assume control over things and activities that once were privately managed, from healthcare to

environmental pollution to behaviour in the workplace. Such moments redefine the rights and responsibilities of states toward their subjects, whether by strengthening or weakening them. They are, straightforwardly, constitutional moments, often designed to correct widely recognized past wrongs.

In the predictive world, however, subjects and obligations are often constituted by less overt means, by redefining the parameters of social concern and social cohesion through developments in science and technology. Economists may have decided that temporally distant risks are nothing to worry about and should be discounted for purposes of action in the present. But climate science, with its powerful push to take planetary sustainability on board as a matter of human concern, upends economics and positions humanity as a steward with the responsibility to care for distant outcomes. As is apparent in the climate case, new tensions may thereby be called forth: between a more expansionist form of politics that willingly engages with bigger temporal and spatial problem definitions and a narrower politics of reaction and retrenchment that prefers to ignore predictions and rely instead upon a more immediate, and local, weighting of distributive outcomes. It is the politics of Greta Thunberg and the child activists against Trump and the American fossil fuel extractors.

Conclusion

Que sera sera, or what will be will be. We know these sayings. They represent for many of us the sense that futures are not ours to see or control. Indeed, for much of human history, the actual represented the limits of the possible. People could not dream of a very different future without invoking an afterlife, god and religion, sin and salvation, heaven and hell. If works on earth in the here and now could enable better future outcomes, those outcomes still were thought to lie in worlds that did not touch ours, across material bridges that were ours to build in the present. Politics, the struggle for worldly benefits, remained a matter of outcomes of the day, fought out in modern democracies within the enclaves of nation states, in accordance with rules of the game created by constitutional orders that knew the difference between public and private, consumer and citizen.

A series of developments in science and technology led from the nineteenth century onward toward a domestication of the future for present-day political action. Statistics allowed entire populations to be enumerated, mapped, and controlled, while computer simulations and the advent of big data created the illusion of a future where human needs and demands would ‘speak for themselves’ and all that politics would need to do would be to find the best solutions. Meantime, the nuclear age and the time bomb of climate change expanded the sphere of necessary political action from the national and international to the global, with associated demands for institutional and political innovation. A drift began toward a conception of politics as a matter of engineering – not normative struggle over the ends and purposes of life – with the state’s engineering instincts hovering between altering the political subject to fit the

rulers' allegedly rational ambitions and altering earth systems, including human biology, to produce distant, but universal, outcomes, such as sustainable development goals. At the same time, largely unregulated social media positioned the digital giants of the twenty-first century as data oligarchs, pitting the power of Google and Facebook against that of national governments in their capacity to constitute new objects of concern, new regulatory instruments, and new political subjects and axes of mobilization.

Predictive politics is here to stay, but the dynamics of the move from the politics of the world-as-it-is to that of worlds-yet-to-come demand a sharper awareness of the moves being made in this transition. Those moves, as argued in this chapter, include shifts in the definition of objects of governance, the development of instruments of intervention, and the constitution of political subjects. In this threefold process, older lines of political agency and self-awareness – most notably the line between public and private – are at risk of being obliterated without adequate critique or response. We need a better mapping of the terrain of predictive politics, and a clearer acknowledgement that the sites and objects of politics are no longer simply those of formal state institutions inherited from the early days of liberal democracy. Too much power to constitute the political now lies in the hands of institutions, deploying new forms of technocapital, that fall outside the bounds of any meaningful political control. Recognizing the domain of socio-technical imaginaries as a field of political action, and demanding the right forms of participation to shape those imaginaries, are essential steps toward reclaiming for this century's citizens an authentic politics of the future.

Notes

1 A well-known example from US politics is the failure of President George H. W. Bush to abide by his much-quoted 1988 campaign promise, 'Read my lips: no new taxes.' He was attacked from both right and left for his failure to hold the line on taxes and lost his bid for reelection in 1992 to the moderate Democratic candidate Bill Clinton.

2 These dates are admittedly somewhat artificial, but they correspond, respectively, to the start of the American Revolution, the Civil War, and the adoption of the Nineteenth Amendment (women's suffrage) to the US Constitution; the French Revolution; the Salt March led by Gandhi in India to protest Britain's oppressive Salt Act; and the anti-extradition protests in Hong Kong.

3 It is worth noting in this context that festering economic and social inequalities tied to race in the United States brought voting rights back to the top of the political agenda after 2016. The decision by failed gubernatorial candidate Stacey Abrams of Georgia to fight against voter suppression instead of herself running for election in 2020 illustrates the point being made here (Cobb 2019).

4 Winner argued famously, if controversially, that New York's famed planner Robert Moses did just this when he planned the highway overpasses leading to the local beaches too low to accommodate buses, the transport means of the poor, but to allow passenger cars, the means favoured by the city's rising middle and upper classes.

5 In the second edition of his extraordinarily influential book, Anderson identified the census, the map, and the museum as additional instruments for creating national

identity, complementing newspapers, the agents of 'print capitalism' that cause people of a given polity to read and identify with the same stories at the same time (Anderson 2006[1983]: 167–90).

6 In Anglo-American common law, courts were historically reluctant to hold private actors responsible for harms that were not 'imminent', which meant in practice legible to courts. These attitudes began changing toward the end of the twentieth century.

7 Extract from a speech by Swedish child activist Greta Thunberg at the UN General Assembly Climate Action Summit on 23 September 2019. For a full transcript, see www.npr.org/2019/09/23/763452863/transcript-greta-thunbergs-speech-at-the-u-n-climate-action-summit (accessed September 2019).

8 President Bill Clinton pointed the way toward this possibility during his remarks on the release of the first map of the human genome in June 2000:

> Just to offer one example, patients with some forms of leukemia and breast cancer already are being treated in clinical trials with sophisticated new drugs that precisely target the faulty genes and cancer cells, with little or no risk to healthy cells. In fact, it is now conceivable that our children's children will know the term cancer only as a constellation of stars.
>
> (White House, Office of the Press Secretary, 26 June 2000, https://clintonwhitehouse3.archives.gov/WH/New/html/genome-20000626.html (accessed September 2019))

References

Anderson, B. (2006[1983]) *Imagined Communities: Reflections on the Origin and Spread of Nationalism, revised edition*, London and New York: Verso.

Beck, U. (1992[1986]) *Risk Society: Towards a New Modernity*, London: Sage.

Beckert, J. (2019) 'The Exhausted Futures of Neoliberalism: From Promissory Legitimacy to Social Anomy', *Journal of Cultural Economy*: 1–13.

Beckert, J. and Bronk, R. (eds) (2018) *Uncertain Futures: Imaginaries, Narratives, and Calculation in the Economy*, Oxford: Oxford University Press.

Calabresi, G. and Bobbitt, P. (1978) *Tragic Choices*, New York: W. W. Norton.

Camic, C., Gross, N. and Lamont, M. (eds) (2011) *Social Knowledge in the Making*, Chicago: University of Chicago Press.

Cobb, J. (2019) 'Stacey Abrams's Fight for a Fair Vote', *New Yorker*, 19 August. Online. Available: www.newyorker.com/magazine/2019/08/19/stacey-abrams-fight-for-a-fair-vote (accessed August 2019).

d'Ancona, M. (2017) *Post-truth: The New War on Truth and How to Fight Back*, London: Ebury Press.

Deringer, W. (2018) *Calculated Values: Finance, Politics, and the Quantitative Age*, Cambridge, MA: Harvard University Press.

Dudley, D. (2017) 'Snowstorm Mayors: Don't Blow This', *Citylab*, 14 March. Online. Available: www.citylab.com/transportation/2017/03/snowstorm-mayors-dont-blow-this/519477 (accessed 8 August 2018).

Edgerton, D. (2011) *Britain's War Machine: Weapons, Resources, and Experts in the Second World War*, Oxford: Oxford University Press.

Edwards, P. N. (2010) *A Vast Machine: Computer Models, Climate Data, and the Politics of Global Warming*, Cambridge, MA: MIT Press.

Espeland, W. N. (1998) *The Struggle for Water*, Chicago: University of Chicago Press.

Foucault, M. (1970[1966]) *The Order of Things: An Archaeology of the Human Sciences*, New York: Random House.

Gross, M. (2010) *Ignorance and Surprise: Science, Society, and Ecological Design*, Cambridge, MA: MIT Press.

Hacking, I. (1990) *The Taming of Chance*, Cambridge: Cambridge University Press.

Hardt, M. and Negri, A. (2000) *Empire*, Cambridge, MA: Harvard University Press.

Hirschman, A. O. (1970) *Exit, Voice and Loyalty: Responses to Decline in Firms, Organizations and States*, Cambridge, MA: Harvard University Press.

Jasanoff, S. (ed.) (2004) *States of Knowledge: The Co-Production of Science and Social Order*, London: Routledge.

Jasanoff, S. and Kim, S.-H. (2009) 'Containing the Atom: Sociotechnical Imaginaries and Nuclear Regulation in the US and South Korea', *Minerva* 47(2): 119–46.

Jasanoff, S. and Kim, S.-H. (eds) (2015) *Dreamscapes of Modernity: Sociotechnical Imaginaries and the Fabrication of Power*, Chicago: University of Chicago Press.

Johnson, D. V. (2016) 'Twilight of the Nudges', *New Republic*, 27 October. Online. Available: https://newrepublic.com/article/138175/twilight-nudges (accessed 16 December 2019).

Kahneman, D. (2011) *Thinking, Fast and Slow*, New York: Farrar, Straus and Giroux.

Keith, D. (2013) *The Case for Climate Engineering*, Boston: Boston Review Books.

MacKenzie, D. (2009) 'Making Things the Same: Gases, Emission Rights and the Politics of Carbon Markets', *Accounting, Organizations and Society* 34: 440–55.

Mitchell, T. (2011) *Carbon Democracy: Political Power in the Age of Oil*, London: Verso.

National Research Council (NRC) (1983) *Risk Assessment in the Federal Government: Managing the Process*, Washington, DC: National Academies Press.

Porter, T. M. (1986) *The Rise of Statistical Thinking, 1820–1900*, Princeton, NJ: Princeton University Press.

Porter, T. M. (1995) *Trust in Numbers: The Pursuit of Objectivity in Science and Public Life*, Princeton: Princeton University Press.

Power, M. (1997) *The Audit Society: Rituals of Verification*, Oxford: Oxford University Press.

Rayner, S., Heyward, C., Kruger, T., Pidgeon, N., Redgwell, C. and Savulescu, J. (2013) 'The Oxford Principles', *Climatic Change* 121(3): 499–512.

Scharpf, F. W. (1997) 'Economic Integration, Democracy and the Welfare State', *Journal of European Public Policy* 4: 18–36.

Sunstein, C. R. (2016) *The Ethics of Influence: Government in the Age of Behavioral Science*, Cambridge, MA: Harvard University Press.

Thaler, R. H. and Sunstein, C. S. (2008) *Nudge: Improving Decisions about Health, Wealth, and Happiness*, New Haven: Yale University Press.

Thompson, D. F. (2010) 'Representing Future Generations: Political Presentism and Democratic Trusteeship', *Critical Review of International Social and Political Philosophy* 13(1): 17–37.

Turkle, S. (1995) *Life on the Screen: Identity in the Age of the Internet*, New York: Simon and Schuster.

Tversky, A. and Kahneman, D. (1974) 'Judgment under Uncertainty: Heuristics and Biases', *Science* 185(4157): 1124–31.

Waldron, J. (2014) 'It's All for Your Own Good', *New York Review of Books*, 9 October. Online. Available: www.nybooks.com/articles/2014/10/09/cass-sunstein-its-all-your-own-good (accessed September 2019).

Wallerstein, I. (2004) *World Systems Analysis: An Introduction*, Durham, NC: Duke University Press.
Weart, S. (1988) *Nuclear Fear: A History of Images*, Cambridge, MA: Harvard University Press.
Weber, M. (1930[1905]) *The Protestant Ethic and the Spirit of Capitalism*, translated by Talcott Parsons, New York: Allen and Unwin.
Winner, L. (1980) 'Do Artifacts Have Politics?', *Daedalus* 109(1): 121–36.

3 How to know the future – and the past (and how not)

A pragmatist perspective on foresight and hindsight[1]

Gunther Hellmann

Much has been written about 'scientific' or other (more or less 'sophisticated') ways of engaging with or thinking about 'the future'. This is one more contribution to a voluminous body of publications. Why so if, as I hasten to acknowledge, no claims to novelty will be made? The simple answer is that much of what we do in scholarship is to arrange and rearrange bodies of scholarship in order, perhaps, to gain a different perspective on a subject matter. This is one such effort. The new perspective which I hope to develop in rearranging different bodies of scholarship in *theorizing social action and thought* (to instantly submit my formula in contrast to notions such as 'epistemology' or 'theory of knowledge') is one which hopefully may ease established strictures in the field of international studies in thinking about 'the future'.

Today's future of international politics is *not* more important than yesterday's although it may look 'darker' than, say, the looming 'new world order' envisaged at the horizon of international politics at the time of the 'end of the Cold War' around 1990. Yet it seems as if the *need* for 'better knowledge' about the future has risen significantly (as the production of books such as this one and, even more so, the proliferation of 'forecasting' and 'scenario building' (including its increasing bureaucratic institutionalization in governments and the private sector) show).

Common understandings of the concept of 'knowledge' normally associate a type of *certainty* with the future which the future, in hindsight, seldom delivers. However, this is not future's fault but ours – at least if we burden 'knowledge' in a futile 'quest for certainty' (Dewey 1929) with notions of 'truth' which are *unreal*. Knowledge as 'know how' is all we can get and all we need – and it is 'know how' largely of the same type about the past, the present and the future. This, in a nutshell, is the thesis which this chapter will develop. I will arrange and rearrange different bodies of literature in order to show that there are good reasons *not* to think that knowledge about the past is fundamentally different from knowledge about the future. These reasons are provided by a tradition of thought roughly labelled 'pragmatist' – *roughly* pragmatist because 'isms' usually subsume under a unifying label authors who tend to insist on the distinctiveness of their respective thinking. Here I assemble authors such as Charles Sanders Peirce, William James, Ludwig Wittgenstein, John Dewey, Hans Georg Gadamer, Wilfrid Sellars, Richard Rorty, Donald Davidson and

Robert Brandom under the label 'pragmatism', again *roughly* only because their work differs in several respects. However, I will argue that they essentially support a pragmatist understanding of 'knowledge' which emphasizes the very practical 'knowing one's way around' ('sich auskennen').[2]

In this understanding one 'knows' one's way around if the descriptions and explanations we provide are *cogent* – i.e. if they resonate, if they are acknowledged and/or if they enable us to cope (better). *Descriptions and explanations* as answers to 'what' and 'why' questions can be thought of as *narratives about how things hang together*. The next section discusses how 'why' and 'what' are often separated in 'positivist' or 'realist' social science in ways which are neither helpful for 'theory-based' backward-looking 'explanation' (hindsight) nor helpful for structurally analogous forward-looking 'prediction' (foresight) – not to mention the 'constitutive' hanging-together of *concepts* (meaning and definition) and *facts* (what is the case). Section 3 grounds these understandings of backward-looking and forward-looking ways of sense-making in the classical pragmatist doctrine of the primacy of practice and in an anti-representationalist perspective on knowledge production influenced by the 'linguistic turn'.

Section 4 elaborates on what it practically means to engage in narration about the past and future along these lines and how it differs from alternative 'epistemological' or 'ontological' understandings emphasizing a strong distinction between 'mind' and/or 'consciousness' on the one hand and 'world' on the other. In section 5 I will argue that the emphasis on the possibilitarian nature of an open past *and* an open future suggests that we should also take into account how an anti-representationalist view of sense-making impinges on the difference between different forms of *projection* (e.g. prediction, forecasting or scenario-building) and *imagination* (e.g. Rawlsian 'realistic utopias') and why the latter should be more appreciated.

Why and what

'Why' is the favoured question word of historians and social scientists. This is so because causation (i.e. the connection of 'causes' and 'effects' about what has *happened*) and justification (i.e. the formulation of reasons why x was *done*) enjoy a privileged status in empirical research and normative theorizing respectively. This privileged status may also easily explain why Charles Tilly, one of the most influential historical sociologists, produced a small book with this very title shortly before he died. The subtitle specified that the book was supposed to explore 'what happens when people give reasons […] and why'. Tilly was puzzled why the mass media as well as his 'fellow social scientists customarily explained complex social phenomena' by focusing 'so regularly on the decision-making of a few influential actors while neglecting unanticipated consequences, incremental effects, and the incessant, subtle negotiation of social interaction' (Tilly 2006: ix).

Following Wittgenstein, puzzlement may equally strike social scientists why 'what'-questions are somehow considered to be *epistemologically* less demanding

than 'why'-questions. There seems to be broad agreement that asking 'why' presupposes that answers to 'what'-questions have already been given and that 'what' is in this sense *prior to* 'why'. 'What'-questions in this understanding are 'What is the case'-questions – questions which usually boil down to conceptual questions of *meaning* and/or factual questions of *description*. In the standard story of 'empirical' social science, conceptual and factual 'what'-questions are easier than causal and normative 'why'-questions because they can, and ought to be, answered quickly. To be sure, 'careful descriptions of specific phenomena' are 'indispensable' even to 'scientific research'. This is even granted by influential authors in 'scientific' research design (King *et al*. 1994: 7).

However, these authors also hasten to add that 'the *accumulation of facts* alone is not sufficient'. Proper scientific research 'requires the additional step of attempting to infer beyond *the immediate data* to something broader that is not *directly observed*' (King *et al*. 1994: 8, emphasis added). In other words, 'description' in this understanding boils down to *the collection of the obvious* – which is why 'scientific' scholars commonly use 'description' jointly with the depreciative qualifier 'mere' (Waltz 1979: 1; Gerring 2012).

As *descriptions*, in this understanding, quickly solve questions of fact, *definitions* quickly solve questions of meaning. In the standard story of 'scientific research' definitions clarify facts in what scientists consider to be *determination* of meaning. This is both necessary and acceptable in order to free observation and analysis for focusing on causation which, in Thomas Kuhn's words, 'invokes an original act of baptism or dubbing as an *essential determinant of reference*' (Kuhn 1990: 309, emphasis added). Causal analysis is then about the nexus between some *definite* thing taken as cause and some *definite* thing taken as effect.

In this chapter I will argue that answers to 'what'-questions and 'why'-questions are *not* as dichotomously different as 'scientific' representations of a strong distinction between ('mere') 'description' on the one hand and (causal) 'explanation' on the other have it. 'What' *and* 'why' both address Sellars' point that philosophy (or, for that matter, social inquiry more broadly) ought to contribute to our understanding of 'how *things* in the broadest possible sense of the term *hang together* in the broadest possible sense of the term'.[3] Translated into the commonly used 'metatheoretical' vocabulary in IR and the social sciences, 'things' may *hang together* constitutively (or conceptually) and they may *hang together* causally. A *description* of different things – i.e. the formation of concepts and the ordering of 'the world' around us by drawing distinctions about what is the case – is as much about some form of 'hanging-together' as are those causal stories connecting 'causes' and 'effects' which we usually call 'explanation'.

The primacy of practice and the necessity and sufficiency of redescriptive sense-making

One can read Wittgenstein as saying more or less the same thing when he hints that we should, in order to solve a (philosophical) 'problem', develop 'perspicuous

descriptions' or 'overviews' of how things are *connected* in everyday linguistic practices:

> A main source of our failure to understand is that we do not *command a clear view* of the use of our words. – Our grammar is lacking in this sort of perspicuity. A perspicuous representation produces just that understanding which consists in 'seeing connexions'. Hence the importance of finding and inventing *intermediate cases*.
>
> (Wittgenstein 1958: §122, emphasis in original)

He adds that 'we must do away with all *explanation*, and description alone must take its place' (1958: §109, emphasis in the original). Because words and concepts lack 'precision' or 'clarity' and because our cognitive and linguistic capacities are delimited the lack of 'a clear view' calls for identifying connections by 'finding' *and* 'inventing' links. In other words, the 'hanging-togetherness' of concepts, descriptions and explanations ought to be expressed not only in passive voice but also in active voice.

Wittgenstein and the tradition of American pragmatism[4] were not in sync on all key issues in the 'philosophy of science'. However, they did share positions on a few issues which are central in thinking about 'the future' and, therefore, worth recalling in a contribution on the 'epistemology' of future studies (for a more detailed discussion, see Grimmel and Hellmann 2019). In the following I will briefly summarize where I see those commonalities and explain why they are directly relevant to our ways of thinking about the future in general and in the field of international politics in particular. At its core it is an argument which combines the classical pragmatist doctrine about the *primacy of practice* ('beliefs are rules for action' (Peirce 1997b[1978]: 33; James 1995[1907]: 18) with the *Gestalt switch* initiated by the *linguistic turn* which, in Richard Rorty's words, 'turned philosophers attention from the topic of experience towards that of linguistic behaviour', thereby 'break(ing) the hold of empiricism – and, more broadly, of representationalism' (Rorty 2007: 160).[5] Let's elaborate on these two dimensions in turn.

The primacy of practice is widely regarded as 'perhaps *the* central' principle of the pragmatist tradition (Putnam 1995: 52, emphasis in original). It is also unquestionably one of the principal beliefs driving the philosophy of the later Wittgenstein.[6] According to this principle, the inevitability of individual and collective action is to be thought of as the necessary starting point of any theorizing about thought and action. Individual and collective action is largely *habitualized* and at the same time *genuinely creative*. As William James put it, the beliefs which guide our action live 'on a credit system'. They '"pass", so long as nothing challenges them' (James 1995[1907]: 80). Yet since we cannot flee from interacting with each other and with the world (and since others and the world keep interfering with us and our beliefs) we habitually have to readjust our habits. In such 'problematic situations' a very *practical* form of 'inquiry' helps us to find appropriate new ways of coping with the respective problems at hand.

Three (Sellarsian) 'things' combine in producing new beliefs and habits: *experience* (roughly: the sum of what we conclude from past thoughts and actions of ourselves as well as others); *expectation* (i.e. hopes and fears as far as desired or disliked future states of the world are concerned); and *creative intelligence* (i.e. 'the function of the mind […] to project new and more complex ends – to free experience from routine and from caprice') (Dewey 1917: 63; Dewey 1991[1938]: 41–7, 105–22, 248–51). The upshot of this emphasis on the primacy of practice is that the *genuine creativity*[7] and, thus, *necessary contingency* of social action has to be taken into account *when* we try to account for it in backward-looking explanations or forward-looking projections of social practice.

The significance of the linguistic turn comes into view when we think about our ways of *accounting* for (creative) human *practice* and (habitualized) social *practices*.[8] In principle, the Peircean and Deweyan notion of 'inquiry' applies in a similar fashion to ('practical') action based on some form of belief *and* to our ('theoretical') ways of *accounting* for action based on some form of belief. Yet language plays a different role in each. Moreover, accounting for social action is fundamentally different from accounting for 'nature' or the physical world. Since 'nature' and 'the world' do not 'speak' (Rorty 1989: ch. 1) the natural sciences are dealing with a world that still needs to be 'discovered' or 'invented', as Heinz von Foerster (1984) once put it – it needs to be *grasped* in the first place.[9] In other words, the object of study of the natural sciences is, at least initially, *meaningless* – and insofar non-existent in an 'epistemological' sense. Only after 'marking the unmarked state' of nature by drawing (linguistic) distinctions (Brown 1972: 5) can we *make sense* of the physical world. In contrast, the social sciences are concerned with a social world *already constituted* by man-made concepts, rules and established practices of describing it. In other words, in doing social science we are necessarily engaging in *redescription* because we are dealing with a terrain that is already constituted and developed by means of human language and, thus, *conceptually autonomous* from our ways of sense-making as the natural world is not (Gunnell 2014: 59–63).

Yet, irrespective of whether we are engaging in ('natural sciences'-type) 'scientific' *description* or ('social sciences'-type) *redescription*, both types of scholarly engagements are inquiring into 'how things in the broadest possible sense of the term hang together in the broadest possible sense of the term' – and they necessarily express the 'hanging-together' of these things *linguistically*. 'Practice theorists' in IR could have taken note of this Wittgensteinian/pragmatist notion of 'hanging-together' more broadly than they actually have, had Ted Schatzki's often cited work of *Social Practices* been taken more seriously (for an exception, see Bueger and Gadinger 2014: 9–11, 63–6). Schatzki had pointed early to the *connected* 'practical' 'hanging-together' of social practices *and* the 'hanging-together' of our 'theoretical' ways of sense-making:

> Human coexistence […] is people forming what is best described with the German word *Zusammenhang*. A *Zusammenhang* is a state of

> held-togetherness. As suggested by the two words that render the German expression in English, 'nexus' and 'context', a *Zusammenhang* is a hanging-together of entities that forms a context for each. Human coexistence is a hanging-together of human lives that forms a context in which each proceeds individually. This formulation is designed to accommodate states of sociality of varying breadths and complexity.
>
> (Schatzki 1996: 14)

Besides this 'practical' side of social 'hanging-togetherness', the 'theoretical' side of *rendering* these social 'things' *as hanging together* is emphasized in Wittgenstein's quote about 'perspicuous representations' ('übersichtliche Darstellung'). Schatzki reads this passage, correctly in my view, as applying equally to the philosopher trying to understand 'the use of our words' and the social scientist 'grasping the spirit expressed in a practice'. He adds that 'grasping the spirit of a practice does not require penetrating or digging below the surface phenomena of life. It requires, instead, gaining a proper overview of the surface' (Schatzki 1991: 318).

This is another way of saying – with Rorty's 'pragmatic Wittgensteinians' (Rorty 2007: 161–75) – that our 'grasping' of practice(s) requires no 'digging below' what one may take to be 'merely' 'surface phenomena of life'. Instead, gaining a *proper overview* of 'the surface' is precisely what is needed – *and* what *must suffice* because there is nothing to be found 'below the surface'. The equivalent thought formed the core insight of the linguistic turn, at least as Rorty himself put it when he initially announced it: '[T]raditional philosophy has been […] largely an attempt to burrow beneath language to that which language expresses.' The adoption of the 'linguistic turn' meant 'that there is nothing to be found by such burrowing' (Rorty 1992[1967]: 10). 'Burrowing beneath' stiffens the wrong-headed 'descriptivist'[10] view that social 'facts' are equivalent to natural facts and that we indeed *can and ought* to 'infer to something broader that is not directly observed' 'beyond the immediate data' which we can somehow easily 'accumulate' (King *et al*. 1994: 8).

Sellars' 'anti-descriptivism' and Rorty's 'anti-representationalism' draw similar lessons from the bad 'epistemological' accounts 'about the relation between language and non-language' in the social world given by previous 'theories of knowledge' (Rorty 1979). They build on the insight of the classical pragmatists who prepared the ground for what Rorty, in hindsight, sees as 'an unnecessary detour' of the 'linguistic turn' in ceasing to 'distinguish between knowing a language and knowing our way around in the world generally' (Rorty 2007: 166). Sellarsian social 'things' are not 'out there' in the world which we represent (correctly or wrongly) as 'data' or 'mental entities'. Instead such supposed 'essences' have been discarded in favour of the view that our linguistic habits are to be thought of 'as strings of marks and noises used by human beings in the development and pursuit of social practices' (Rorty 1992[1967]: 373).

Representationalism is problematic, because it misrepresents how we actually *make sense* of the past, the present and the future when we *redescribe* it in terms

of how 'things hang together'. It misrepresents these ways of sense-making because it falls prey to what Andreas Schedler calls the 'double false consciousness' of 'dual reification' (Schedler 2011). 'Dual reification' means that representationalists look at concepts in terms of the classical distinction between 'mental creations' and 'real objects' while at the same time reifying both sides of the mind–world distinction. The error of 'reification of reference' lies in the mistake of treating what is referred to in the social world as *objects* with 'observable' properties rather than taking it as a conventionalist linguistic abstraction of symbolic realities. The error of 'reification of concepts' boils down to the mistake of treating concepts themselves as if they were tangible objects, fixed in time and space with observable properties instead of looking at them as tools for coping.

Many influential 'isms' in contemporary social science – i.e. '(neo-)positivism', 'scientific realism' and even many versions of 'constructivism' – are committed to such a representationalist view. Alexander Wendt, for instance, who has been one of the most influential IR scholars during the past decades in shaping IR 'meta-theoretical' discussions with his importation of 'scientific realism' implicitly defends a representationalist perspective when he chastises 'anti-realist' 'empiricists' and 'postmodernists' to 'privilege epistemology over ontology'. His central charge in his early, 'pre-quantum social science phase' was (and in that regard largely remains[11]) that 'anti-realist' empiricists and postmodernists did not sufficiently 'ground meaning and truth in an external world that regulates their content'.[12] Instead of an empiricist 'description theory of reference' or a postmodernist 'relational theory' which 'emphasizes relations among words' Wendt favoured what he calls a 'realist' causal theory of reference: 'Discourse' may 'affect meaning'. However, this 'does not mean that meaning is *entirely* socially or mentally constructed. In the realist view beliefs are determined by discourse *and* nature' which presumably

> solves the key problems of the description and relational theories: our ability to refer to the *same object* even if our descriptions are different or change, and the resistance of the world to certain representations. Mind and language help determine meaning, but *meaning is also regulated by a mind-independent, extra-linguistic world*.

The anti-representationalist position favoured by Richard Rorty, Donald Davidson or political scientist John Gunnell, does not only entail a different grouping of 'schools of thought'. It also boils down to the argument that the strong distinction drawn by Wendt and fellow representationalists between 'realists' and 'anti-realists' misses a *fundamental similarity* in outlook among them and even arises as a problem only for representationalism (Rorty 1991: 2). According to the anti-representationalist view the very idea that language 'represents' objects 'out there in the world' is misleading because it is based on what Donald Davidson calls the 'dualism of scheme and world' which engenders talk about 'relativism' (and its conceptual opposite, 'absolutism') in the first

place (Davidson 2001: 40, 46). To be sure, the world and language are 'both autonomous'. But

> the world only appears in the concepts embedded in our language or, as Wittgenstein put it, 'essence is expressed in grammar', which 'tells us what kind of object anything is' […] Wittgenstein emphasized that it is in the application of language within human practices that language makes contact with the 'world' and that this was also where the 'world' finds expression.
>
> (Gunnell 2011a: 136; the reference is to Wittgenstein 1958: §§371, 373)

Concepts, therefore, do not 'refer' or 'represent' things 'in the world'. Rather 'they are kinds of things designated and discriminated by various forms of linguistic usage' (Gunnell 2011a: 136).

Narrating the past and future by hanging things together

Acceptance of the primacy of practice and the necessity (and sufficiency) of redescription changes how we look at our ways of making sense of the past, present and future. Hindsight and foresight – my alternative suggestions for a host of largely synonymous concepts such as 'historical explanation', 'prediction' or 'forecasting' which carry too much 'epistemological' baggage – basically reflect a similar *narrative* structure.[13] When we explain (looking backward) or predict/forecast (looking forward) we similarly combine what we take to be meaningful linguistic expressions in ways which help us to make sense of the past, present or future – and, thus, enable us to cope (better).

The explanations we give and the forecasts we offer gain credibility (or 'validity'), and thus become candidates for what we consider to be 'knowledge', not because we can claim a special status of 'truth' for them but because these explanations or forecasts *resonate* in the sense that we are willing to *act* upon them. This is the old insight offered by Charles Sanders Peirce almost 150 years ago when he explained how we 'fix' our 'beliefs' as a result of an 'irritation of doubt (which) causes a struggle to attain belief' – a 'struggle' he termed 'inquiry':

> The irritation of doubt is the only immediate motive for the struggle to attain belief. It is certainly best for us that our beliefs should be such as may truly guide our actions so as to satisfy our desires; and this reflection will make us reject any belief which does not seem to have been so formed as to insure this result. But it will only do so by creating a doubt in the place of that belief. With the doubt, therefore, the struggle begins, and with the cessation of doubt it ends. Hence, the sole object of inquiry is the settlement of opinion. We may fancy that this is not enough for us, and that we seek, not merely an opinion, but a true opinion. But put this fancy to the test, and it proves groundless; for as soon as a firm belief is reached we are entirely satisfied, whether the belief be true or false. And it is clear that nothing out

> of the sphere of our knowledge can be our object, for nothing which does not affect the mind can be the motive for mental effort. The most that can be maintained is, that we seek for a belief that we shall *think* to be true. But we think each one of our beliefs to be true, and, indeed, it is mere tautology to say so.
>
> (Peirce 1997a[1877]: 13–14, emphasis in original)

Obviously, this view positions Peirce (as well as all subsequent pragmatists) clearly on the side of the anti-foundationalist and fallibilist critics of notions of 'knowledge' as 'justified true belief' because the qualifiers 'justified' and 'true' add nothing at all to the quality of 'belief' to the extent that we are *willing to act* upon it. Of course, there is a difference between an *explanation* (or belief) about something that has already happened and a forecast (or belief) about something that lies ahead in the future in the sense that the former has been actualized whereas the latter remains in the realm of pure possibility for the time being. However, the function of the respective *belief* (as 'know-how') is similar because it is considered to be 'justified' and 'true' in both cases to the extent that we are willing to act upon it. There is also a certain difference if we aggregate *individual* beliefs at a *collective* level. However, this is a difference of degree, not of principle. 'Believers' of the laws of gravity and 'believers' of Jesus Christ, Karl Marx or, for that matter, Donald Trump *act* upon their beliefs irrespective of whether what they believe in is doubtful for others (Rorty 1989: 5–7). They are 'entirely satisfied' that their beliefs are 'true' and 'justified' *for them*. Wittgenstein hints that he equally sees little difference between *shared* 'beliefs' and 'knowledge' when he writes that 'knowledge is in the end based on acknowledgement'.[14]

This understanding of the direct link between 'belief' and 'action' is relevant for our understanding of hindsight and foresight because the underlying Peirceian and Deweyan notion of 'inquiry' always applies in the same fashion to solve *practical* and *theoretical* problems.[15] Irrespective of whether policy-makers in a defence ministry are devising a (forward-looking) medium-term security strategy, whether EU bureaucrats are developing 'scenarios' for the future of the European Union (European Commission 2017) or whether 'scholars' or other 'experts' in the field of IR or European Studies are writing about these policy processes as 'mere' observers – the underlying 'theory of inquiry' (Dewey) is always applied to solve some problem in order to cope.

This is important because it differs fundamentally – 'epistemologically' or 'ontologically', depending on your preferred Sellarsian 'exotic specimen' from 'the gardens of philosophy' referred to above – from 'empiricist', 'positivist', 'realist' or (in my preferred terminology) *representationalist* alternatives which stick to a strong 'mind'/'consciousness' ← → 'world' distinction. The very notion of 'a 1:1 correspondence between theory and reality' (Wendt 2015: 66) is only the most recent version of representationalism in IR, even though it is now clothed in a 'quantum' vocabulary. Its central problem from the point of view of a pragmatist ('beliefs are rules for action') vocabulary is that its *probabilistic*

(Wendt 2015: 3–4, 40, 154–61) view of quantum social action remains essentially stuck (as old-fashioned Hempelian logical empiricism and its many 'positivist' IR variants) in the determinism of 'scientific explanation' and 'prediction' which, in Hempel's words, 'have the same logical character: they show that the fact under consideration can be inferred from certain other facts by means of specified general laws' (Hempel 1958: 37).

From a pragmatist point of view this is problematic because it systematically ignores the open-endedness of *possibility* as a result of genuinely creative social action – or, as Rorty and Brandom agree: It is problematic because representationalists *cannot* have any sense for 'the role of vocabularies in changing what we want and even what we need' (Rorty 2000: 188; Brandom 2000: 170). In his later writings Rorty granted that earlier he may have been 'in danger of overromanticizing novelty by suggesting that great geniuses can just create a new vocabulary *ex nihilo*'. Yet he continues to emphasize that 'inquiry' ought to be understood 'as enlarging our imagination, and thus our alternatives' rather than to think of it in terms of predictive success as 'getting more and more things right' (Rorty 2000: 188).

A possibilistic (rather than a probabilistic or even deterministic) view of past- and future-oriented thinking may be seen to contrast too starkly with any reasonable understanding of 'knowledge', even in the Peirceian understanding which takes it largely as collectively held belief. And indeed, there is a critical difference between 'the past' which is 'closed' in the sense of *actually having taken place* and 'the future' which is 'open' in the sense of still to be actualized in one way *or* the other. Yet even though the distinction between belief and action is primarily *analytical* rather than in any strong sense *temporal* (i.e. 'action' temporally following 'belief') past and future *practice(s)* are clearly distinct from our *ways of making sense* of actualized practices in the past and *possibly* actualized practices in the future. This is why, in real life, the difference between future-oriented 'possibility' and 'probability' may merely amount to the difference between a form of practical inquiry which is satisfied with creatively managing the evolving interplay between means and ends on the one hand and the epistemological idea (or fancy) on the other hand that the management of this interplay may somehow be 'controlled' in percentage-terms as in the natural sciences. The *metaphorical* roots of the German word for 'probability' ('Wahrscheinlichkeit', literally: the *appearance* of *truth*[16]) in any case strengthen that point.

Possibility therefore opens broader horizons for the future – and the past – which is why (in a very different sense compared to the Hempelian thesis of structural equivalence between explanation and prediction) hindsight and foresight are indeed not as distinct as strong 'futurologist' research posits.

The openness of past and future and the promise of possibilistic imagination

Prediction, forecasting or scenario-building as academic (or scholarly) tools of future-oriented projection usually imply (and entail) an assumption of *epistemic*

control associated with notions of determinism or probabilism.[17] Possibilism, in contrast, might be thought of as a set of beliefs that things *may* hang together (or, for that matter, *be hung together* via narration) in ways which we may not (yet) understand because our ways of making sense of things have not (yet) developed a vocabulary to *make* such sense. The point of drawing this distinction between determinism and probabilism on the one hand and possibilism on the other is not that the former is somehow misleading whereas the latter is not. Rather it is to point to a dimension of *openness* of past and future with *possibilities* of social action which we cannot yet describe because of the genuine creativity of social action (which, of course, includes both the creativity of the action itself as well as the creativity in coming up with cogent descriptions) and which deterministic or probabilistic forms of foresight may fail to appreciate sufficiently.

This is another way of saying that belief in the fundamental *contingency* of social action cautions us to systematically allow for *possibility* in making sense of both the past and the future. Geoffrey Hawthorn has developed this argument most thoroughly with regard to historical explanation by pointing out that in explaining social phenomena we always face the *inherent* paradox that *possibilities* at once decrease *and* increase. The former is obvious since we expect a good explanation to identify those causes which made a *particular* outcome possible (rather than some alternative). However, the better our explanation the more it will have to draw on counterfactual reasoning, that is, engage in a discussion of plausible *alternative* developments: If we were to slightly change some of the initial conditions, an alternative path would have been more plausible instead. In other words, the force of an explanation turns on the counterfactual which it implies – and in this sense, the horizon of possibilities is also systematically increasing in any good explanation as it decreases (Hawthorn 1991: 17). These possibilities, however, are not *knowable* in the positivist sense of 'precisely' locating counterfactuals[18] since we do not dispose of a reliable method to 'precisely' define the *horizon* of possibilities making up the world. In any case, the notion of a *complete description* of *all* available possibilities would at least be incompatible with a belief in the genuine creativity of human agency (Emirbayer and Mische 1998: 983–91).

In this sense, Hawthorn argues, we can achieve better *understanding* of the past by exploring the possibilities implied in counterfactual reasoning, but we can never 'know' the past in any strong sense. The corollary of this argument as far as foresight is concerned is, in analogous fashion, that our grasp or understanding of the future may improve to the extent that we explore as broad a range of possibilities as possible. Yet here the critical difference between past and future – the former actually having been *actualized*, whereas the latter has not – multiplies the complication of counterfactual reasoning (i.e. that possibilities increase *and* decrease at the same time) since we lack the 'factual' in counterfactual reasoning. In other words, possibilities are ubiquitous since we cannot even *know* how to reliably differentiate between the possible and the

impossible. Ironically, Wittgenstein here provides a telling example about the insight that 'what we believe depends on what we learn'.

> We all believe that it isn't possible to get to the moon; but there might be people who believe that that is possible and that it sometimes happens. We say: these people do not know a lot that we know. And, let them be never so sure of their belief – they are wrong and we know it. If we compare our system of knowledge with theirs then theirs is evidently the poorer one by far.
>
> (Wittgenstein 1984: §286)

Already in the late 1940s when Wittgenstein wrote these lines his *knowledge* claim about the impossibility of 'getting to the moon' was contested by some who believed this to be possible in principle[19] even though nobody yet had the opportunity to practically *learn* that this utopia was realistic indeed. Thus, since beliefs about the possible and the impossible are a matter of learning and since we cannot know today what we may learn tomorrow, foresight (i.e. 'understanding' the future based on a version of future-oriented 'counter-possible' reasoning) is obviously more complicated than hindsight (i.e. understanding the past based on counterfactual reasoning).

The conclusion to be drawn from this insight is not that future-oriented projections based on assumed (deterministic or probabilistic) epistemic control are useless. Rather, it is that the propagated (or, at least, *implicitly assumed*) epistemic *superiority* often associated with 'theory'-based prediction, forecasting or scenario-building in contrast to more 'fictitious' forms of imagination is precarious indeed. This is so not only because we (should) *know* that we cannot draw a clear line between the possible and the impossible but also because, practically speaking, 'fictions also "remake" human action or praxis as the practical fictions which are called ideologies and utopias' (Ricoeur 1979: 123). Moreover, a welter of sociological research should have taught us that Robert Merton's adaptation of the 'Thomas theorem'[20] in inventing the 'self-fulfilling prophecy' provides for a constant constraint in our intellectual engagement with the future because future-oriented hopes or fears will inevitably affect subsequent developments to the extent that they become an integral part of the *projected* definition of the situation (Merton 1948: 195).

In international relations (as well as and in IR) there is a tendency to practise what Merton also assumes to be his definitional criterion of a self-fulfilling prophecy, i.e. that fears (rather than hopes) dominate future-oriented thinking. For instance, one of the central practices of systematic future-oriented thinking in foreign policy-making, i.e. threat assessment as a key ingredient of strategy-making and defence planning, is, by definition, based on bad-case or even worst-case thinking. Similarly the dominance (or at least: ubiquity) of 'positivism' and 'realism' in IR discourse also provides for an inbuilt disciplinary tendency towards conceiving of future possibilities in deterministic or probabilistic ways epistemologically and in sceptical or even pessimistic terms substantively.

Thus, practical as well as normative reasons can be mobilized why the expansion of horizons of possibility in future-oriented thinking may indeed be advisable. Rather than merely engaging the future deterministically or probabilistically a form of possibilistic 'inquiry' which focuses on 'enlarging our imagination' by adding *preferred* futures to *likely* futures will be helpful in that regard. Richard Rorty and John Rawls may differ on a number of issues. However, what Rorty calls 'imagination' as a special form of 'recontextualization' is similar to Rawls' plea for 'realistic utopias'.[21] It is based on a distinction between inference and imagination.

> We speak of inference when logical space remains fixed, when no new candidates for belief are introduced. Paradigms of inference are adding up a column of figures, or running through a sorites, or down a flow-chart. Paradigms of imagination are the new, metaphorical use of old words (e.g., gravitas), the invention of neologisms (e.g., 'gene'), and the colligation of hitherto unrelated texts (e.g., Hegel and Genet [Derrida]).
>
> Rorty 1991: 94)

Imagination, thus, expands 'logical space' by allowing for new beliefs or vocabularies in a similar fashion as Rawlsian 'realistic utopias' extend 'what are ordinarily thought of as the limits of practical political possibility' (Rawls 1999: 11). Emphasizing ends and goals as being 'achievable' (Rawls 1999: 6) rather than focusing on forces or trends on trajectories beyond our control also has the advantage of encouraging agency to change or affect the course of events in terms of our preferences, including the possible side effects that might accrue as a result of the dynamics of self-fulfilling prophecies built on hopes rather than fears.

Conclusion

Nobody doubts that *things hang together* in the world *and* in our ways of making sense of the world. Contestation arises about the 'how'. Representationalists maintain that our ways of sense-making 'correspond' to how things 'really' are in the world. Anti-representationalists, in contrast, emphasize that our ways of hanging things together in a constitutive or causal sense are primarily the result of bets that these ways of sense-making will enable us to cope (better).

One of the central arguments of this chapter has been that the basic narrative structure of sense-making applies in analogous fashion to the past (hindsight) and the future (foresight). We will not be able to achieve 'knowledge' in the sense of *certainty* or 'justified true belief' because the contingency of social action usually offers multiple possibilities for acting and for explaining such action. This is not a problem since *knowledge as acknowledgement* (i.e. as ways of sense-making that resonate in relevant fields of social action) is all we can get – and all we need because it allows us to relate to the past and the future in terms of acting upon it.

Allowing for an expansion of horizons of possibility does not only help to ease 'epistemological' strictures it also allows to move beyond empiricist fixations on causal determinism and probabilism, especially as far as our ways of thinking about the future is concerned. Since there is ample evidence that our desires and normative preferences influence both hindsight and foresight and since scholarship as well as practitionership in the field of international relations are shaped by a 'realist' tendency to privilege threats over opportunity in future thinking, the injection of some imagination and a few 'realistic utopias' in addition to the proliferating practice of forecasting and scenario building will not hurt.

Notes

1 I am grateful for comments to the editors as well as Volker Heins, Frank Gadinger, the participants in the Research Colloquium of 'Käte Hamburger Kolleg' (KHK), Duisburg and Patrick Th. Jackson. I am also grateful to KHK more broadly for enabling me to carry out this and additional research in the course of a six-month fellowship.

2 Cf. Sellars (1963[1962]: 1), Wittgenstein (1958: §123), Gadamer (1989[1960]: 250–2) and Grondin (2002: 37–40).

3

> The aim of philosophy, abstractly formulated, is to understand how things in the broadest possible sense of the term hang together in the broadest possible sense of the term. Under 'things in the broadest possible sense' I include such radically different items as not only 'cabbages and kings', but numbers and duties, possibilities and finger snaps, aesthetic experience and death. To achieve success in philosophy would be, to use a contemporary turn of phrase, to 'know one's way around' with respect to all these things, not in that unreflective way in which the centipede of the story knew its way around before it faced the question, 'how do I walk?', but in that reflective way which means that no intellectual holds are barred.
>
> (Sellars 1963[1962]: 1)

4 Robert Brandom, Richard Rorty's student and Wilfrid Sellars' colleague who is considered to belong to this tradition as well has characterized Sellars' philosophy as 'pragmatism of a recognizably late-Wittgensteinian sort'. He also ranks him as 'the greatest American philosopher of the middle years of the twentieth century' (Brandom 2015: 1, 5).

5 On different readings of the 'linguistic turn', see Rorty (1992, 1967).

6 On Wittgenstein as one of the key sources of 'practice theory' or the 'practice turn', see Schatzki (1996) and Stern (2003) respectively.

7 The pragmatist understanding of *situated* and *genuinely creative* social action is most systematically reconstructed in Joas (1996).

8 It needs to be highlighted that the distinction between (more strongly *creative*) 'practice' in the singular and (more strongly *habitualized*) 'practices' in the plural is a *weak* one since the so-called 'practice turn' in IR has been too heavily fixated on the latter. As a result, IR 'theorizing' of 'practices' has overemphasized the *repetitive* features of 'habits' which suited the *generalizing* 'theory' instincts of positivist 'science' much more easily than the Deweyan emphasis on the *genuine creativity of all social action* would allow for.

9 The German word for 'grasping' is 'begreifen' – and the verb 'begreifen' is related to the noun 'Begriff' (or 'concept'). In other words, to 'grasp' what is going on in nature involves naming, describing or conceptualizing the things we observe.

10 On empiricist 'descriptivism' and Sellars' 'anti-descriptivism', see Brandom (2015: 93–7).
11 To be sure, today's 'later Wendt' of 'quantum social science' (Wendt 2015) has dropped a major part of the theoretical vocabulary of the 'early Wendt'. Yet in arguing 'that human beings and therefore social life exhibit *quantum coherence* – in effect, that we are walking wave functions' and by insisting that this argument is not meant 'as an analogy or metaphor, but as a realist claim about *what people really are*' he is essentially sticking with the core programme of his early 'realism' (Wendt 2015: 3, emphasis added; Wendt 1999).
12 All quotes in the remainder of this paragraph from Wendt (1999: 57), with the exception of the 'and' connecting 'discourse and nature'; all emphases have been added.
13 On the role of narrative in general, see Abbott (2002); on its role in history, see White (1987); on 'political narratives', see Gadinger *et al*. (2014); on future narratives, see Dahlhaus and Weißkopf (2017).
14 Wittgenstein (1984: §378): 'Das Wissen gründet am Schluß auf der Anerkennung.'
15 Recall that 'theory' here simply carries the Gadamerian notion of 'seeing what is' (Gadamer 1998: 31).
16 On the conceptual history of 'Wahrscheinlichkeit', see Blumenberg (1960: 88–105).
17 'Probabilism' here stands for a belief (or 'epistemology') that opinions display different grades of plausibility or rationality in the sense of being justifiably acknowledgeable as *true* belief; see Jeffrey (1992: 44–5).
18 For instance, given their necessarily deterministic (or at least probabilistic) understanding of causality King, Keohane and Verba, believe that it is possible 'to define the counterfactual conditions making up each causal effect very precisely' (King *et al*. 1994: 89).
19 Robert H. Goddard, a recognized pioneer of space exploration, published a basic mathematical theory underlying rocket propulsion and rocket flight in 1919 which included calculations about reaching the moon, developments, Goddard argued, which 'involve many experimental difficulties, to be sure; but they depend upon nothing that is really impossible' (Goddard 1919: 57); see also Clary (2003: 124–7).
20 'If men define situations as real, they are real in their consequences' (Thomas 1928: 572), quoted according to Merton (1995: 380).
21 'Political philosophy is realistically *Utopian* when it extends what are ordinarily thought to be the limits of practicable political possibility and, in so doing, reconciles us to our political and social condition' (Rawls 1999: 11, emphasis in the original).

References

Abbott, P. H. (2002) *The Cambridge Introduction to Narrative*, Cambridge: Cambridge University Press.

Bernstein, R. J. (1995) 'American Pragmatism: The Conflict of Narratives', in J. Guinlock and H. J. Saatkamp (eds) *Rorty and Pragmatism: The Philosopher Responds to His Critics*, Nashville: Vanderbilt University Press, 54–67.

Blumenberg, H. (1960) 'Paradigmen zu einer Metaphorologie', *Archiv für Begriffsgeschichte* 6: 7–142.

Brandom, R. B. (2000) 'Vocabularies of Pragmatism: Synthesizing Naturalism and Historicism', in R. B. Brandom (ed.) *Rorty and His Critics*, Malden, MA: Blackwell Publishers, 156–83.

Brandom, R. B. (2015) *From Empiricism to Expressivism: Brandom Reads Sellars*, Cambridge, MA: Harvard University Press.

Brown, G. S. (1972) *Laws of Form*, New York: Julian Press.

Bueger, C. and Gadinger, F. (2014) *International Practice Theory: New Perspectives*, Houndmills, Basingstoke: Palgrave Macmillan.

Clary, D. A. (2003) *Rocket Man: Robert H. Goddard and the Birth of the Space Age*, New York: Hyperion.

Dahlhaus, N. and Weisskopf, D. (2017) *Future Scenarios of Global Cooperation: Practices and Challenges, Global Dialogues 14*, Duisburg: Käte Hamburger Kolleg/Centre for Global Cooperation Research.

Davidson, D. (2001) *Subjective, Intersubjective, Objective*, Oxford: Oxford University Press.

Dewey, J. (1917) 'The Need for a Recovery of Philosophy', in J. Dewey, A. W. Moore, H. C. Brown, G. H. Mead, B. H. Bode, H. W. Stuart, J. H. Tufts and H. M. Kallen (eds) *Creative Intelligence: Essays in the Pragmatic Attitude*, New York: H. Holt and Company, 3–69.

Dewey, J. (1929) *The Quest for Certainty: A Study of the Relation of Knowledge and Action*, London: George Allen & Unwin.

Dewey, J. (1991[1938]) *Logic: The Theory of Inquiry, The Later Works, 1925–1953, Vol. 12*, edited by Jo Ann Boydston, Carbondale and Edwardsville, IL: Southern Illinois University Press.

Emirbayer, M. and Mische, A. (1998) 'What is Agency?', *American Journal of Sociology* 103: 962–1023.

European Comission (2017) *White Paper on the Future of Europe: Reflections and Scenarios for the EU27 by 2025*, Brussels: European Commission.

Gadamer, H.-G. (1989[1960]) *Truth and Method*, London: Continuum.

Gadamer, H.-G. (1998) *Praise of Theory*, New Haven: Yale University Press.

Gadinger, F., Jarzebski, S. and Yildiz, T. (2014) *Politische Narrative: Konzepte, Analyse, Forschungspraxis*, Wiesbaden: Springer VS.

Gerring, J. (2012) 'Mere Description', *British Journal of Political Science* (42): 721–46.

Goddard, R. H. (1919) *A Method of Reaching Extreme Altitudes*, Smithsonian Miscellaneous Collections 71(2), Washington, DC: Smithsonian Institution.

Grimmel, A. and Hellmann, G. (2019) 'Theory Must not Go on Holiday. Wittgenstein, the Pragmatists and the Idea of Social Science', *International Political Sociology* (13): 198–214.

Grondin, J. (2002) 'Gadamer's Basic Understanding of Understanding', in R. J. Dostal (ed.) *The Cambridge Companion to Gadamer*, Cambridge: Cambridge University Press, 36–51.

Gunnell, J. G. (2011a) *Political Theory and Social Science: Cutting against the Grain*, New York: Palgrave McMillan.

Gunnell, J. G. (2011b) 'Social Scientific Inquiry and Meta-Theoretical Fantasy: The Case of International Relations', *Review of International Studies* 37: 1447–69.

Gunnell, J. G. (2014) *Social Inquiry after Wittgenstein and Kuhn: Leaving Everything as It Is*, New York: Columbia University Press.

Hawthorn, G. (1991) *Plausible Worlds: Possibility and Understanding in History and the Social Sciences*, Cambridge: Cambridge University Press.

Hempel, C. G. (1958) 'The Theoretician's Dilemma: A Study in the Logic of Theory Construction', in H. Feigl, M. Scriven and G. Maxwell (eds) *Concepts, Theories, and the Mind-Body Problem*, Minneapolis: University of Minnesota Press, 37–98.

James, W. (1995[1907]) *Pragmatism*, New York: Dover Publications.

Jeffrey, R. (1992) *Probability and the Art of Judgement*, Cambridge: Cambridge University Press.

Joas, H. (1996) *The Creativity of Action*, Oxford: Polity Press.
King, G., Keohane, R. O. and Verba, S. (1994) *Designing Social Inquiry: Scientific Inference in Qualitative Research*, Princeton: Princeton University Press.
Kuhn, T. S. (1990) 'Dubbing and Redubbing: The Vulnerability of Rigid Designation', in W. C. Savage (ed.) *Scientific Theories*, Minneapolis: University of Minnesota Press, 298–318.
Mearsheimer, J. J. and Walt, S. M. (2013) 'Leaving Theory Behind: Why Simplistic Hypothesis Testing is Bad for International Relations', *European Journal of International Relations* 19, 427–57.
Menand, L. (1997) 'An Introduction to Pragmatism', in L. Menand (ed.) *Pragmatism: A Reader*, New York: Vintage Books, xi–xxxiv.
Merton, R. K. (1948) 'The Self-Fulfilling Prophecy', *The Antioch Review* 8: 193–210.
Merton, R. K. (1995) The Thomas Theorem and the Matthew Effect: *Social Forces* 74: 379–424.
Peirce, C. S. (1997a) 'The Fixation of Belief', in L. Menand (ed.) *Pragmatism: A Reader*, New York: Vintage Books, 7–25.
Peirce, C. S. (1997b) 'How to Make our Ideas Clear', in L. Menand (ed.) *Pragmatism: A Reader*, New York: Vintage Books, 26–48.
Putnam, H. (1995) *Pragmatism: An Open Question*, Oxford: Blackwell.
Rawls, J. (1999) *The Law of Peoples*, Cambridge, MA: Harvard University Press.
Ricoeur, P. (1979) 'The Function of Fiction in Shaping Reality', *Continental Philosophy Review* 12: 123–41.
Rorty, R. (1979) *Philosophy and the Mirror of Nature*, Princeton: Princeton University Press.
Rorty, R. (1989) *Contingency, Irony, and Solidarity*, Cambridge: Cambridge University Press.
Rorty, R. (1991) *Objectivity, Relativism, and Truth*, New York: Cambridge University Press.
Rorty, R. (1992) [1967] *The Linguistic Turn: Essays in Philosophical Method: With Two Retrospective Essays*, Chicago: The University of Chicago Press.
Rorty, R. (2000) 'Response to Robert Brandom', in R. B. Brandom (ed.) *Rorty and His Critics*, Malden, MA: Blackwell Publishers, 183–90.
Rorty, R. (2007) *Philosophy as Cultural Politics, Philosophical Papers Vol. 4*, Cambridge: Cambridge University Press.
Schatzki, T. R. (1991) 'Elements of a Wittgensteinian Philosophy of the Human Sciences', *Synthese* 87: 311–29.
Schatzki, T. R. (1996) *Social Practices: A Wittgensteinian Approach to Human Activity and the Social*, Cambridge: Cambridge University Press.
Schedler, A. (2011) 'Concept Formation', *International Encyclopedia of Political Science*, Thousand Oaks: Sage, 370–82.
Sellars, W. (1956) 'Empiricism and the Philosophy of Mind', in H. Feigl and M. Scriven (eds) *Minnesota Studies in the Philosophy of Science*, Minneapolis, MN: University of Minnesota Press, 253–329.
Sellars, W. (1963[1962]) 'Philosophy and the Scientific Image of Man', in W. Sellars (ed.) *Science, Perception and Reality*, Atascadero, CA: Ridgeview Publishing Company, 35–78.
Stern, D. (2003) 'The Practical Turn', in S.P. Turner and P. A. Roth (eds) *The Blackwell Guide to the Philosophy of the Social Sciences*, Malden, MA: Blackwell Publishing, 185–206.

Tilly, C. (2006) *Why? What Happens When People Give Reasons … and Why*, Princeton: Princeton University Press.

von Foerster, H. (1984) 'Disorder/Order: Discovery or Invention', in P. Livingston (ed.) *Disorder and Order: Proceedings of the Stanford International Symposium*, Saratoga: Anma Libri, 273–84.

Waltz, K. N. (1979) *Theory of International Politics*, Reading, MA: Addison-Wesley.

Wendt, A. (1987) 'The Agent-Structure Problem in International Relations Theory', *International Organization* (41): 335–70.

Wendt, A. (1999) *Social Theory of International Politics*, Cambridge: Cambridge University Press.

Wendt, A. (2015) *Quantum Mind and Social Science: Unifying Physical and Social Ontology*, Cambridge: Cambridge University Press.

White, H. (1987) *The Content of the Form: Narrative Discourse and Historical Representation*. Baltimore: Johns Hopkins University Press.

Wittgenstein, L. (1958) *On Certainty*, Oxford: Basil Blackwell.

Wittgenstein, L. (1984) 'Über Gewissheit', in L. Wittgenstein, *Werkausgabe, Band 8*. Frankfurt am Main.

4 Future thinking and cognitive distortions

Key questions that guide forecasting processes

Michael C. Horowitz

From a student trying to decide how hard to study for a test based on their beliefs about the benefits and drawbacks to a traveller deciding how early to get to the airport based on their beliefs about the length of the security line, much of human activity involves forecasting. And, of course, people would rather be right than wrong. No one wants to leave the umbrella home on a day when it rains. But if the weather report says there is a 20 per cent chance of rain, few will take an umbrella to work, and two out of ten times, you'll get rained on.[1]

The notion that cognitive biases shape how we view the past, present, and future is an idea as old as thinking itself. When Socrates criticized the sophists and their emphasis on rhetoric over substance, he was pointing out the way that humans can be easily persuaded to make decisions based on their feelings, rather than evidence (Guthrie 1969).[2] This is undoubtedly related to traditional limitations in how individuals and organizations conceptualize forecasting. Philosopher Karl Popper famously contrasted two views of the world – a clock-like vision that human events move with precision, and a cloud-like vision expressing the inherent uncertainty and unpredictability of human life (Popper 1965; also see Tetlock and Gardner 2016). Why is it that we struggle to effectively forecast even when it seems plausible, based on the questions being asked?

This chapter lays out a new framework for thinking about forecasting and the factors that lead to bias in how we view the world. Three questions are critical. First, what are the things that can be forecast versus those that cannot? Predicting human-driven events such as mass killings or wars is extremely complex. Second, who is doing the forecasting? Some forecasting involves individuals, such as policy-makers, trying to understand the world. Other forecasting involves groups making decisions (see Janis 1982; Hart *et al*. 1997; Tetlock 1979; Mintz and Wayne 2016).[3] Third, how are they doing the forecasting, e.g. what methodology? Some forecasting involves individuals or groups using historical analogies to derive expectations about how countries will behave. Other methods include crowd-sourced forecasting or even machine learning.

Breaking down these three questions helps reveal some possible biases that influence forecasting, and thus more and less accurate ways of viewing the

world. Measuring judgemental accuracy is critical for understanding who is right (setting aside, for a moment, questions about the objectivity of truth in general). Policymakers also rely on judgement accuracy. Policy-makers want to know what will happen in the world, as well as how different policy options will shape the world that results. Analysts in the intelligence community or foreign policy community spend their careers attempting to predict relatively rare events, such as Russia's invasion of the Crimea. Gaining a greater understanding of these topics is thus not only academically important, but important for the policy world as well.

Forecasting and the role of cognitive and organizational bias

Understanding forecasting, and the way that biases shape our ability to forecast, requires answering a series of questions about the forecasting process. These questions, and the analysis that follows, are less a rubric or a blueprint for accurate forecasting than an attempt to unpack the way that different biases infiltrate the forecasting process.

Question 1: What is being forecast?

The first question focuses on the topic under consideration. In the broadest sense, there are things that are extremely difficult to forecast, such as the formation of hurricanes or other processes for which, while not entirely random, there are no known ways to accurately forecast. There are other topics, such as economic growth, where there are well developed models that, much of the time, accurately predict what is likely.[4]

One challenge is that the policy world, as well as the academic international relations world, often focuses on rare events such as the outbreak of war (Cohen 2002). Interstate war is an extremely rare event in international politics. From a dyadic perspective, for example, war happens in less than 1 per cent of the dyadic interactions between pairs of states across human history (Singer 1987). Thus, political science models of war are necessarily looking for a needle in a haystack (Bennett and Stam 2004). Similarly, in the policy world, continuity is more likely than change (think of the outbreak of war as a change). What is likely to happen in any given day in US–Russian relations or US–China relations is what happened the day before. Crises are rare, in the grand scheme of things.

This is one reason why it is easier, in general, to forecast continuity rather than change. For example, in 2011, the Intelligence Advanced Research Project Agency (IARPA), a section of the Office of the Director of National Intelligence, sponsored a multi-year forecasting tournament with competing teams. Each team had to enter forecasts, using whatever methodology it chose, on questions ranging from whether North Korea would test a nuclear weapon by a certain date to who would win the 2012 Russian election. The Good Judgment Project (GJP), based at the University of Pennsylvania and UC-Berkeley,

emerged as the winner of the tournament using a variety of crowd-sourced forecasting methods, including pooling individual forecasts with a weighting algorithm, and using prediction markets.[5]

The Good Judgment Project represents one of the most successful large-scale forecasting demonstrations to date, and on topics vital to foreign policy and national security. Yet some issues likely made the Good Judgment Project's task somewhat easier than the hardest forecasting challenges. All questions were time-delimited. Because of the nature of the tournament, questions had to have an end-date. This necessary (for the purposes of the competition) limit on the duration of questions meant that the difficulty of questions in any given year depended on what was going on in the world, as well as the creativity of those writing the questions. If, for example, East Asia was fairly quiet from a foreign policy perspective in a given year, questions involving foreign policy in Asia (example: Will there be a national confrontation between national military forces in the East China Sea between X date and Y date) would be easier than if crises involving China or North Korea were ongoing.

The forecasting data bore this out. GJP forecasting methods were generally more effective on questions where the terminal result of the question was continuity with the status quo (e.g. when North Korea did *not* test a nuclear weapon by a certain date) than on those with an end-state that involved change in the world (e.g. when North Korea *did* test a nuclear weapon by a certain date). While GJP's methods did offer a great deal of accuracy on questions that involved change in the world, its greatest success involved predicting continuity.

Predicting continuity may be important on its own, however, due to the possibility that subject matter experts may over-predict change due to the burden of their knowledge. Take a question about whether there will be a confrontation between US and Russian military forces in Ukraine in a certain time period. Subject matter experts, those with knowledge beyond the educated reader of the *New York Times* (Tetlock 2005), understand all the different causal pathways through which war can erupt. They understand, in theory, Putin's psychology, US military posture, the disposition of Ukrainian military forces, and other issues. Knowing all of the low-probability ways that war could occur may lead experts to over-estimate the probability of change. Experts may, without knowing it, simply add the number of ways that war could occur, even though the overall probability of war is extremely low.

In contrast, educated readers of the *New York Times*, understanding that war is very unlikely but not burdened with the knowledge of all of the low-probability ways that war could break out, may see war as less likely. Thus, in a normal situation, e.g. where war does not occur, the experts will look like they are falsely over-predicting change.

But most important in this area, the questions that are asked and the resources provided to answer them almost certainly bias the results and perceptions of accuracy. For example, there is the apocryphal story that the US Defense Intelligence Agency only had two analysts focused on Iraq's WMD programmes prior

to the First Gulf War. After the war, when Iraq's WMD pursuits turned out to be much more extensive than the United States had previously understood, it raised the question of why such an under-estimation occurred.[6] One answer is simply resources: The United States did not ask the right questions and sufficiently resource research on the answers. More generally, if individuals or organizations are not asking the right questions, getting the right answers becomes impossible. Therefore, to the extent recency bias, for example, leads organizations to only focus on potential crises in areas where crises have recently occurred, it may bias them away from asking questions in other areas and anticipating the next crisis.

Question 2: Who is doing the forecasting?

The next question, after what is being forecast, involves who is doing the forecasting. Who is doing the forecasting here primarily involves whether it is individuals or groups forecasting, and the biases that can result. The struggles of groups at accurately assessing the world is well-diagnosed. Janis' groupthink construct still shapes how much of the academic and policy world thinks about group decision-making. Groupthink involves the convergence of opinions and cutting off of debate, prematurely, within groups, due to social pressure (including power, status, fear of exclusion, and other issues). By making effective deliberation less likely, organizations that fall prey to groupthink are more likely to make bad decisions both in non-crisis and crisis situations (Janis 1982).

There are ways to improve group decision-making, of course. For example, given the way status biases how people evaluate information (the higher the status of a person, the more likely others are to view that person as correct), having individuals of similar status work together on groups tasks, or work together virtually where they do not know the others they are working with, can mitigate status bias. Making it easier for individuals to defect from the group without being excluded in the future, deliberately building in red teaming, and encouraging conversational norms that do not just let the 'boss' dominate the conversation can also improve group dynamics.

Individuals, however, struggle with forecasting as well, for a variety of well-known reasons from psychology. It is not possible, in the confines of this chapter, to outline the universe of potential cognitive biases. Instead, I will highlight a few that are potentially relevant for forecasting global events. Confirmation bias involves searching for information that comports with preexisting beliefs, and evaluating information through the lens of preexisting beliefs, rather than objectively evaluating information about whether something is likely to occur (Jermias 2001). A classic example of this is analysts that believed Saddam Hussein had an active WMD programme prior to the invasion of Iraq interpreting intelligence information in ways that fit their preconceived views of the world (Jervis 2006).

This can be especially problematic due to the multiplicative effect of anchoring bias. Anchoring bias is when individuals fixate on one particular piece of

information – often the first piece of substantive information they receive about a situation – when interpreting the situation (Tversky and Kahneman 1975). From a public opinion perspective, this is one reason why politicians sometimes attempt to get in front of issues and shape the narrative. By shaping how people feel at the outset, they will anchor on that piece of information and be more likely to believe the rest of the explanation by the politician. In negotiating, anchoring functions by helping set a price on a good. The initial price a car dealership sets on a car, for example, shapes the offers people will make on that car. People do not want to vary too far from the initial anchor. Thus, the process of initial price-setting defines the outer limits of the sale price of the car.

Recency bias and the availability heuristic also shape how people view the world. People naturally have better memories of things that have happened more recently. They also gravitate towards available information. People tend to search for information where it is easiest to find, like the famous example of the drunkard looking for his keys under the lamppost since that is where the light is. This can be problematic from a foreign policy forecasting perspective in two ways. First, recency bias means people think the next crisis or area of importance is likely to look like that last one. This is related to the idea that militaries 'fight the last war' by planning for a war based on linear lessons learned from the last war the military fought. The availability heuristic beyond the recency effect can involve famous or prominent examples from history biasing how people view what is most likely in a given situation. For example, European appeasement of Hitler at Munich, and the result of encouraging Hitler's aggression, became a famous example of the danger of appeasement used by analogy in future situations (Khong 1992). Alternatively, US participation in the Vietnam War, for another group of elites, became a powerful analogy used to describe the dangers of foreign policy quagmires.

Finally, identity-protective cognition is a relatively new construct with potentially great relevance for thinking about forecasting in the foreign policy realm. Identity-protective cognition involves the way that people are specifically biased when evaluating information than challenges their identity, including their perceived potential for success in the future. For example, Air Force pilots are more likely to view airpower as effective for the projection of military power, whereas Army officers are more likely to think landpower and armour is necessary to project military power.

Question 3: What forecasting methodology is being used?

In the last several years, there has been growing interest in political forecasting both inside and outside of academia. While much of this growth comes from a new generation of models designed to forecast US elections,[7] scholars are also focusing to a greater extent on forecasting in the geopolitical and economic realms as well. Despite the concerns of scholars such as Jervis (1997) that complexity in political interaction makes effective forecasting nearly impossible, researchers are exploring a variety of methods to generate forecasts on political

events historical data (Bennett and Stam 2006), agent based models (Lustick 2000), and various forms of expert judgement (Tetlock 2005). Bruce Bueno de Mesquita (2010), for example, uses a combination of expert input and game theory to generate point predictions of diplomatic and military events.

Some forecasting research utilizes cross-sectional, time-series data or panel data to train models that then make predictions about the probability of events such as coups, civil wars, or other types of conflicts. Most prominently, research conducted by the Political Instability Task Force has produced increasingly accurate models of political instability (Goldstone *et al*. 2010). Research on predicting interstate disputes and other types of political instability using underlying cross-sectional, time-series data on contentious issues, as well as political and behavioural variables at the nation-state level, has also shown promise (Ward *et al*. 2010; Gleditsch and Ward 2013; Goldsmith *et al*. 2013). Another set of forecasting research uses event data, both within and between countries, to forecast international and domestic conflict (Arva *et al*. 2013; Schrodt 1991; Pevehouse and Goldstein 1999; O'Brien 2010).

This growth in research on forecasting naturally raises questions about what types of models are better for forecasting what types of political events, as well as how it is that these models get things right. In economics, looking at stock prices and other data-rich economic indicators, Timmerman and others compare the accuracy of human forecasters to statistical models when predicting earnings, interest rates, and other outcomes (Timmermann 2006; Pesaran *et al*. 2006; Capistrán and Timmermann 2009). This research suggests that when there is general continuity, machine-based models are extremely successful. However, during periods of change, machine models, even if highly accurate during periods of continuity and programmed in ways that are supposed to incorporate the potential for change, lag in accuracy.

Finally, the largest amount of forecasting done in academia and the policy world does not involve explicit models at all. Instead, most forecasting involves one of two things: scenario planning or analogical reasoning. Forecasting by scenario planning is about process as much as outcome. Consider the US National Intelligence Council's 20-year forecasts, which are published every five years. They engage groups of experts inside and outside the governments to assess trends and use scenario planning to lay out alternative pathways, or futures, for the world.

All of these methods have their limits, and those limits are well known. The most frequent forecasting that happens in the policy world, however, involves none of these explicit methodologies. Instead, the most frequent forecasting in the policy world, especially in the national security world, involves elites attempting, on their own or in small groups, to understand how other actors are likely to behave in a crisis or near-crisis situation.

Here, the failure to consult base rates represents an important bias. Base rates are simply the average probability of a given type of event occurring. Imagine a crisis over whether North Korea will test a nuclear weapon in a certain case. There are a variety of base rates that are potentially relevant, including how

often North Korea tests nuclear weapons, how often countries test nuclear weapons in general, and how often North Korea engages in provocative behaviour. Which is the most important base rate for a decision-maker to consult when trying to understand whether North Korea will test a nuclear weapon? All of them, potentially. Or maybe none of them. But this is an explicit choice that should be made, instead of what often happens. What often happens is that implicit base rate models, drawn from the experiences of the decision-maker or group of decision-makers, shapes the discussion without those assumptions ever being explicit.

Additionally, decision-makers may sometimes view each crisis as unique. If a policy-maker sees a crisis as unique, an 'N+1' question, it makes them less likely to evaluate explicit models of the past and what happens on average. They are more likely to view base rates as irrelevant. Instead, when considering an 'N+1' case, policy-makers are more likely to anchor their proposed views of the crisis based on instincts drawn from a few particular historical cases that shape their knowledge of the situation, and/or their efficacy beliefs, their understanding of what strategies are more effective than others. Of course, decision-makers that make this argument are not wrong, because each crisis or scenario is somewhat unique. Yet each may also have commonalties with the past, as the recourse to historical analogies and their own experience suggests.

Note that what the decision-makers are doing here still involves forecasting: using a model of how the world works to make a prediction about how an actor or group of actors is likely to behave. But the model is implied, rather than explicit, making it harder to question any assumptions that might be flawed. Moreover, the probabilities they assign to things are generally word-based ('likely', 'less likely', etc.) rather than number-based, making them less likely to be accurate (and harder to assess in their accuracy).[8] It is not surprising that decision-makers prefer their own judgement. After all, they are placed in positions of great authority in part based on their reputation for accurately understanding the world. However, when decision-makers ignore explicit models that could give them base rates or other information concerning a given crisis while still relying on implicit models, it represents a bias of sorts.

Conclusion

Given that cognitive biases shape how individuals and groups fundamentally view the world, thus skewing their forecasting, how can we ever hope to accurately perceive the world? Part of the answer may involve more clearly understanding the first question posed in this chapter, regarding what is being forecast. Some questions are simply harder to forecast than others, but we often do a bad job of distinguishing the difficulty of the forecasting problem. This has implications both for how accurately we expect to be able to perceive the world and how we should evaluate the accuracy of various forecasting models or analysts

who engage in forecasting. For example, rewarding people for accurate judgement when they predict an extremely rare event, or punishing people that do not predict the same event, may place too much weight on what might be a semi-random outcome. In a one-shot forecast, who is right and wrong may reflect chance as much as skill.

Instead, forcing people whose accuracy is viewed as important to more consistently forecast, and giving them accuracy feedback on their forecasts, is more likely to make them more accurate when it comes to forecasting the rare event. More frequent forecasting can also help organizations judge what people or methods, within the organization, are better at forecasting.

Additionally, training in probability judgements and cognitive biases can help people self-correct. Perfect bias correction is not possible, as Kahneman (2011) reminds us. Yet the Good Judgment Project's experience demonstrated that those who received training in how to assess probabilities (such as learning about base rates) and in cognitive de-biasing improved their forecasting accuracy by 7 to 10 per cent (Mellers *et al*. 2015). Broader understanding of how we are biased can make people think twice when they evaluate the world, making it less likely that subconscious bias overly shapes their viewpoints.

Finally, being explicit about the models we use to forecast, regardless of the methodology, can help improve our understanding of the world. Different models and methods, from analogical reasoning to machine learning to prediction markets, may be more or less efficient across different scenarios. Refusing to consider the appropriate match between the model, the method, and the situation is a mistake. Given that problem-solving often involves forecasting, even if that forecasting is implicit, there is much to potentially gain by being explicit about how people view the world and what they are using to derive a forecast. Making assumptions explicit also makes them easier to question, making them more robust and able to survive scrutiny. Making assumption explicit also helps in identifying faulty assumptions. Thus, developing more accurate ways to view the world is not a task for any one field or any one method. Instead, it is a matter of more explicit and consistent activity.

Notes

1 This is a commonly used story. For a recent prominent exposition, see Silver (2012).
2 Also, on persuasion bias, see DeMarzo *et al*. (2003).
3 An example, as discussed below, is the type of group interactions that lead to groupthink or polythink dynamics.
4 There is a stationary issue with economic growth models where many are better at predicting continuity than change.
5 Full disclosure: I was one of the researchers associated with the Good Judgment Project. For more on the methods that led to GJP's success, see Mellers *et al*. (2015), Tetlock and Gardner (2016).
6 There is irony here that bureaucratic politics can help us explain, in the subsequent US over-estimation of Iraq's WMD programme prior to the invasion of Iraq in 2003.

7 This includes both Nate Silver's forecasts of the 2008 and 2012 elections (for more on his forecasting methods, see Silver 2012) as well as forecasting by academics such as the Princeton Election Consortium: http://election.princeton.edu.

8 See recent research on how numerical forecasting improves accuracy (Friedman *et al*. 2018, Friedeman *et al*. 2017).

References

Arva, B., Beieler, J., Fisher, B., Lara, G., Schrodt, P. A., Song, W. Sowell, M. and Stehle, S. (2013) *Improving Forecasts of International Events of Interest*, EPSA 2013 Annual General Conference Paper.

Bennett, D. S. and Stam, A. C. (2004) *The Behavioral Origins of War*, Ann Arbor: University of Michigan Press.

Bennett, D. S. and Stam, A. C. (2006) 'Predicting the Length of the 2003 US-Iraq War', *Foreign Policy Analysis* 2(2): 101–16.

Bueno de Mesquita, B. (2010) *The Predictioneer's Game: Using the Logic of Brazen Self-Interest to See and Shape the Future*, New York: Random House.

Capistrán, C. and Timmermann, A. (2009) 'Disagreement and Biases in Inflation Expectations', *Journal of Money, Credit and Banking* 41(2-3): 365–96.

Cohen, E. A. (2002) *Supreme Command: Soldiers, Statesmen, and Leadership in Wartime*, New York: Free Press.

DeMarzo, P. M., Zwiebel, J. and Vayanos, D. (2003) 'Persuasion Bias, Social Influence, and Uni-Dimensional Opinions', *Quarterly Journal of Economics* 118(3): 909–68.

Friedman, J. A., Baker, J. D., Mellers, B. A., Tetlock, P. E., Zeckhauser, R. (2018) 'The Value of Precision in Probability Assessment: Evidence from a Large-Scale Geopolitical Forecasting Tournament', *International Studies Quarterly* 62(2): 410–22.

Freidman, J. A., Lerner, J. S., Zeckhauser, R. (2017) 'Behavioral Consequences of Probabilistic Precision: Experimental Evidence from National Security Professionals' *International Organization* 71(4): 803–26.

Gleditsch, K. S. and Ward, M. D. (2013) 'Forecasting Is Difficult, Especially about the Future: Using Contentious Issues to Forecast Interstate Disputes', *Journal of Peace Research* 50(1): 17–31.

Goldsmith, B. E., Butcher, C. R., Semenovich, D. and Sowmya, A. (2013) 'Forecasting the Onset of Genocide and Politicide: Annual Out-Of-Sample Forecasts on a Global Dataset, 1988–2003', *Journal of Peace Research* 50(4): 437–52.

Goldstone, J. A., Bates, R. H., Epstein, D. L., Gurr, T. R., Lustik, M. B., Marshall, M. G., Ulfelder, J. and Woodward, M. (2010) 'A Global Model for Forecasting Political Instability', *American Journal of Political Science* 54(1): 190–208.

Guthrie, W. K. (1969) *A History of Greek Philosophy, Vol. 3: The Fifth Century Enlightenment*, New York: Cambridge University Press.

Hart, P., Stern, E. and Sundelius, B. (1997) *Beyond Groupthink: Political Group Dynamics and Foreign Policy-Making*, Ann Arbor, MI: University of Michigan Press.

Janis, I. L. (1982) *Groupthink: Psychological Studies of Policy Decisions and Fiascoes*, Boston: Houghton Mifflin.

Jermias, J. (2001) 'Cognitive Dissonance and Resistance to Change: The Influence of Commitment Confirmation and Feedback on Judgment Usefulness of Accounting Systems', *Accounting, Organizations and Society* 26(2): 141–60.

Jervis, R. (1997) *System Effects: Complexity in Political and Social Life*, Princeton, NJ: Princeton University Press.

Jervis, R. (2006) 'Reports, Politics, and Intelligence Failures: The Case of Iraq', *The Journal of Strategic Studies* 29(1): 3–52.

Kahneman, D. (2011) *Thinking, Fast and Slow*, New York: Macmillan.

Khong, Y. F. (1992) *Analogies at War: Korea, Munich, Dien Bien Phu, and the Vietnam Decisions of 1965*, Princeton, NJ: Princeton University Press.

Lustick, I. S. (2000) 'Agent-Based Modelling of Collective Identity: Testing Constructivist Theory', *Journal of Artificial Societies and Social Simulation* 3(1): 1–24.

Mellers, B., Stone, E., Atanasov, P., Rohrbaugh, N., Metz, S. E., Ungar, L., Bishop, M. M., Horowitz, M., Merkle, E. and Tetlock, P. (2015) 'The Psychology of Intelligence Analysis: Drivers of Prediction Accuracy in World Politics', *Journal of Experimental Psychology: Applied* 21(1): 90–103.

Mintz, A. and Wayne, C. (2016) *The Polythink Syndrome: US Foreign Policy Decisions on 9/11, Afghanistan, Iraq, Iran, Syria, and ISIS*, Stanford, CA: Stanford University Press.

O'Brien, S. P. (2010) 'Crisis Early Warning and Decision Support: Contemporary Approaches and Thoughts on Future Research', *International Studies Review* 12(1): 87–104.

Pesaran, M. H., Pettenuzzo, D. and Timmermann, A. (2006) 'Forecasting Time Series Subject to Multiple Structural Breaks', *The Review of Economic Studies* 73(4): 1057–84.

Pevehouse, J. C. and Goldstein, J. S. (1999) 'Serbian Compliance or Defiance in Kosovo? Statistical Analysis and Real-Time Predictions', *Journal of Conflict Resolution* 43(4): 538–46.

Popper, K. R. (1965) *Of Clouds and Clocks: An Approach to the Problem of Rationality and the Freedom of Man*, St. Louis: Washington University.

Schrodt, P. A. (1991) 'Prediction of Interstate Conflict Outcomes Using a Neural Network', *Social Science Computer Review* 9(3): 359–80.

Silver, N. (2012) *The Signal and the Noise: Why So Many Predictions Fail – But Some Don't*, New York: Penguin Press.

Singer, J. D. (1987) 'Reconstructing the Correlates of War Dataset on Material Capabilities of States, 1816–1985', *International Interactions* 14(2): 115–32.

Tetlock, P. (1979) 'Identifying Victims of Groupthink from Public Statements of Decision Makers', *Journal of Personality and Social Psychology* 37(8): 1314.

Tetlock, P. (2005) *Expert Political Judgment: How Good Is It? How Can We Know?* Princeton, NJ: Princeton University Press.

Tetlock, P. and Gardner, D. (2016) *Superforecasting: The Art and Science of Prediction*, New York: Random House.

Timmermann, A. (2006) 'Forecast Combinations', *Handbook of Economic Forecasting* 1: 135–96.

Tversky, A. and Kahneman, D. (1975) 'Judgment under Uncertainty: Heuristics and Biases', in D. Wendt and C. Vlek (eds) *Utility, Probability, and Human Decision Making*, New York: Springer: 141–62.

Ward, M. D., Greenhill, B. D. and Bakke, K. M. (2010) 'The Perils of Policy By P-Value: Predicting Civil Conflicts', *Journal of Peace Research* 47(4): 363–75.

5 Thinking historically

A guide for policy

Francis J. Gavin

There is a renewed interest in exploring how history and historians might contribute to the policy-making process. Several impressive initiatives have been created, both in the United States and abroad. Recently, Graham Allison and Niall Ferguson have recommended that the next president of the United States create a White House Council of Historical Advisors, staffed by scholars who go beyond simply studying the past 'for its own sake' and instead pursue what they call applied history. 'Applied historians would take a current predicament and try to identify analogues in the past. Their ultimate goal would be to find clues about what is likely to happen, then suggest possible policy interventions and assess probable consequences' (Graham and Ferguson 2016). This builds upon a similar plea, made over 40 years ago, by the historian Ernest May. Worried in the aftermath of the Vietnam War that policy-makers used history poorly, May (1973: 190) claimed 'nothing is more important than that professional historians discover means of addressing directly, succinctly, and promptly the needs of people who govern'.

How should we think about and assess efforts to apply the past to contemporary and future policy? How can policy-makers gain from engaging the past, and what might historians contribute to better governance and decision-making? And what are the prospects for applied history? As this volume highlights, there are important epistemological, political, and ethical dimensions of these questions. From a political perspective, historians have not been key parts of the conversation with policy-makers. At times, this is because policy-makers demand certainty and prediction, whereas historians traffic in uncertainty, unintended consequences, and context. Other times, it is the historians who resist engagement. There are a variety of reasons for this, but ethical ones stand out. First, most academic historians see their role as confronting and challenging power and those that hold it, not providing tools for statecraft. Second, historians have moved with great innovation in recent decades to better reflect and capture the underrepresented voices of those without power. Writing to aid those in policy can be uncomfortable. Yet wrestling with these very dilemmas – how to represent varying perspectives, and challenging the simple use of knowledge to advance power and the powerful – can inject a sensibility into the policy process that can make it not only more effective, but also more just. Social

science, despite its other benefits, rarely tackles the ethical dimensions of power that are the stock-in-trade of historians.

This chapter proceeds as follows. The first section examines the epistemological issues surrounding prevision, highlighting how a historical sensibility links the past to the present and future. The second section suggests five tools a historical sensibility can provide to policy-makers trying to make sense of a complex world and uncertain future. The third provides additional lessons or insights that highlight both the challenges and promise of using history for prevision.

A historical sensibility as a bridge between the past and the future

Using history for policy-making can be complicated and, if not handled judiciously, counterproductive. On the one hand, everyone reasons from historical analogy, and policy-makers invariably search the past for usable lessons to help them navigate complex situations and make difficult choices (for an excellent overview of how policy-makers use history, see Inboden 2014). On the other, the past is often misunderstood, misappropriated, and/or misused, and even in the best hands, history rarely provides point predictions or recommends specific courses of action. Untamed, history is a dangerous and mercurial lover, who will always tell you what you want to hear. Or to paraphrase A. J. P. Taylor (1963), 'men learn from their past mistakes how to make new ones'.

I have written elsewhere about the possibilities and problems with effectively employing a historical approach to policy (Gavin 2007). This is especially true when it comes to the interest of policy-makers in prevision, a concern historians understand and value differently. Part of the issue is that historians and policy-makers have different goals and interests. History cannot tell a decision-maker what policy to choose, and the typical historian's answer to a question – 'well, it is complicated' – is frustrating to a person making decisions under time pressures, and often reinforces the policy-maker's suspicion that scholars are obtuse and irrelevant. It may even paralyze the analyst: 'Understanding the complexity of human affairs, seeing clearly both sides of all issues, knowing that few things work out the way we intend, may breed in us caution and indecisiveness' (Wood 2009: 15). Furthermore, history often eschews the underlying epistemological foundations many social scientists believe necessary for prevision. Historians often fail to be explicit about the conceptual foundations of their work, nor do they acknowledge, let alone specify, what theories of the world drive their questions, how their evidence is selected, how a causal hierarchy is conceived, and how a narrative is constructed. Few believe this vagueness is a problem. Nor does history provide much in the way of generalizable principles or theories to frame policy. There is little effort in academic history to prioritize subjects from the past, and one can easily get the sense that 'anything matters'. While historians, more than most disciplines, recognize the problems of subjectivity and perspective, they make very little effort to get around it. An obsession

with history can blind an observer to new trends, new patterns, and departures from the past.

The historian, for her part, can be skeptical about how the policy-maker is using the past in their policy-making, both for intellectual and ethical reasons. As Margaret MacMillan (2009) points out, 'History can be helpful; it can also be very dangerous'. The scholar fears that history – and especially historical analogies – will be used less to explain or understand than to justify a position or provide comfort. Historians are painfully aware that the modern state building project and the rise of many of the academic social sciences has gone hand in hand, for both good and ill. Narratives of the past are often misused for the foundation for national myths, to overlook injustice or mistakes. Oftentimes, historians find their carefully undertaken research distorted for political purposes. Consider John Dower, who found his award winning historical work on the occupation of Japan misused by the George W. Bush administration in its defence of its policies in Iraq. 'They keep on hitting it and hitting it and hitting it and it's always more and more implausible, strange and in a fantasy world. They're desperately groping for a historical analogy, and their uses of history are really perverse' (Zenilman 2007).

Clearly, there are powerful reasons for policy-makers and historians to be wary of one another, and in particular, to be skeptical of the concept of applied history. That said, to misquote Churchill, history may be the worst academic discipline to help decision-makers, save for all the others. Or to put it another way, many of history's greatest weakness are also its strengths. The most powerful argument for engaging history, I would argue, is less its substantive or methodological advantages than something harder to define: Engaging the past in a serious and sustained way helps a decision-maker to develop a historical temperament or sensibility.What do I mean by a 'historical sensibility'? It goes beyond our notions as to *what* historians do: Collecting evidence, largely from archives, to tell stories about the past. I define it as a familiarity with the past and its powerful and often unpredictable rhythms. A historical sensibility is less a method than a practice, a mental awareness, discernment, responsiveness to the past and how it unfolded into our present world. Developing this sensibility can provide many benefits and insights to the decision-maker facing complex issues and radical uncertainty about the future, not the least of which is humility and prudence. Scholar and policy-maker Eliot Cohen has termed it the 'historical mind', which he aptly describes as a 'way of thinking shaped by one's reading of history and by using history as a mode of inquiry and a framework for thinking about problems' (Cohen 2005: 575). The combination of history with concerns about present and future policy is not as unusual as may first seem. All history is to some extent contemporary history, while all policy choices emerge from decisions made in the past.

What are the qualities to this orientation, and how can one obtain it? A historical sensibility includes several characteristics. First, this sensibility demonstrates a toleration and even appreciation of uncertainty, surprise, and unintended consequences in human affairs, and a comfort with indeterminacy

and multi-causal explanations. It makes the unfamiliar familiar, while revealing the unfamiliar in what was believed was well understood. Furthermore, the historical sensibility provides an empathy (though not necessarily a sympathy) for the past, a willingness to understand historical subjects on their own terms and as products of a particular time and place. This also means developing a consciousness of the powerful hold that history exerts on other cultures, leaders, and nations. It also acknowledges the fundamental importance of the perspective of the observer. Though the historian strives for an elusive objectivity, she admits that the who, what, and when of the historian matter quite a bit when reconstructing the past. Finally, a historical sensibility recognizes and appreciates complexity, and though willing to be proven wrong, casts a skeptical eye on claims of parsimonious models that claim to explain, generalize, and predict complex social, cultural, and political behaviour. As Gordon Wood (2009: 11) eloquently stated:

> To possess a historical sense does not mean simply to possess information about the past. It means to have a different consciousness, a historical consciousness, to have incorporated into our minds a mode of understanding that profoundly influences the way we look at the world.

It is important to note that the historian does not develop his or her sensibility solely (or even primarily) to aid policy. In fact, the term 'policy relevance', which suggests that scholarship should be tethered to the aims of the state and government, is potentially off-putting. Furthermore, historians have different views of what we mean by expertise and who does and should exercise authority. The better term, to my mind, is 'public minded' (for a helpful essay that breaks down the elements of policy-oriented scholarship, see Horowitz 2015). While this is fodder for a whole different essay, there is little doubt that academic history as a discipline has, unfortunately, over the past four or five decades become increasingly obsessed with issues and subjects of little interest to a larger public (and often, it must be said, of little interest to other historians either). Engaging the concerns of audiences outside the ivory tower, to develop a public mindedness, can generate enormous civic benefits without a scholar feeling as if they have lost their objectivity or become corrupted by connections to politics and power. In other words, a historical sensibility can provide insight and value without necessarily becoming applied or involve hiring professional historians to work in the government. It would be a 'declaration of bankruptcy on the part of historical scholarship if the work of the historian stopped short of the most burning issues of the day' (Gilbert 1970: xi).

There are at least two possible objections to my suggestion that policy-makers develop a historical sensibility. First – and understandably – few non-historians want to hear about such intangible traits or a quality as elusive as a 'sensibility', which come, if at all, after years of historical study. To the more scientifically oriented, this sounds like mystic nonsense, and to the harried, time pressured decision-maker, unusable gobblydegook. Few have the time,

inclination, or luxury to develop a 'sensibility' overnight. Part of the blame, it should be pointed out, stems from an identity crisis within history itself. Consensus on method, mission, and purpose has long eluded the academic historical undertaking. Within universities, historians are as likely to be found within a humanities school as a division of social science. Outsiders might be surprised to learn that one of history's most esteemed practitioners, Jacques Barzun (1974: 24), believed 'History has no need of mathematical precision because it deals with activity and not process.' To Barzun (1974: 24), 'History owns affinity with art, poetry, philosophy, and religion, to which few would deny the possibility of precision and truth though they are untestable by rule.' It is hard to imagine an applied version of what Barzun practised.

A second critique is whether this sense for the past has any use for understanding the present or the future. In other words, can one 'think historically' in the present tense, and undertake contemporary historical analysis? Some historians believe that doing history in 'real-time' is impossible for two reasons: First, good historical work demands perspective, which only comes with the passage of time, and second, historical materials, especially sensitive documents, are often classified and left closed in archives for years if not decades. According to Bruce Kuklick (2006: 159), 'Historical knowledge depends on a temporal perspective. Events take on their historical meaning with the passage of time.' Any effort to do history in real time will be burdened by contemporary prejudices and perspectives, and lack the kind of first-hand evidence historians crave.

There is merit to this critique. It would be unfortunate, however, to deny policy-makers the benefits of a historical approach simply because circumstances are not ideal. The first point to make is that all historical work reveals the bias and assumptions of the time it was written. It is hard to read Christopher Clark's description of the Black Hand of Serbia in *The Sleepwalkers* and not think of Pakistan or Islamic terror groups. As Simon Schama (1989: xiii) explained in his masterwork on the French Revolution, *Citizens*, 'Historians have been overconfident about the wisdom to be gained by distance, believing it somehow confers objectivity, one of those unattainable values in which they have placed so much faith.' A historically oriented analyst might actually be more aware of their own biases and work harder to overcome them. The second point involves evidence. While documents may be classified, the contemporary observer may have access to far more (open source) evidence, including their own experiences, which are perishable over time. There is a reason that detectives try to solve capital crimes within the first 48 hours they are committed, because evidence quickly disappears after too long.[1] The absence of evidence can also provide a false unanimity. Historical consensus on a distant event in the Middle Ages might be easier to achieve, because the evidence is so rare.

Contemporary historical analysis, therefore, can provide powerful insights. E. H Carr (1961: 22), quoting Croce, reminds us that 'all history is "contemporary history"'. Whether looking at the past or current events, Carr (this time quoting Lord Acton) tells us that 'history must be our deliverer not only

from the undue influence of other times, but from the undue influence of our own, from the tyranny of environment and the pressure of the air we breathe' (1961: 44). Certainly, this way of thinking, this lens for understanding the world around us, can provide insight for a decision-maker.

Five uses of the historian's microscope

Understandably, the practice of history is expected to provide more than a sensibility. Are there tools and methods historians offer that go beyond temperament or sensibility? For many historians, the term 'applied' may be too brusque and clinical. Historians argue over what happened in the past and why, and embrace a wide range of methods and tools to construct their narratives. Even if you could get them to agree these histories and practices could be applied profitably to the present – a difficult task – it would be impossible to achieve consensus on the best way to do so.

Perhaps a better model is one developed by historian and policy-maker Philip Zelikow, comparing how one understands and assesses the past to how certain biological sciences work. According to Zelikow, the analyst possesses two ways to assess and understand the past. The first is through a macro view comparable to 'gross anatomy', where simplification and generalizations are the rule. Social scientists, like macroeconomists and international relation theorists pursue this path, as do, if to a far lesser extent, historians. The historian, however, also assesses the past through the micro level, where the 'historian's microscope' must be used to understand the confounding complexity and unusualness of the past:

> The path of complexity is difficult, but the rewards include more lifelike fitness training for the intellect. And seen through a microscope, including a historian's microscope, the world can be far stranger and more fascinating than anything that can be seen by the unaided eye.
>
> (Zelikow 2015: 282–3)

The best historical work, and the adept historical sensibility, combines and integrates the best insights from both of these methods, to develop both a better understanding of the past and what it can tell us – and not tell us – about the choices and circumstances we face today. Sympathetic to the concerns of both the social scientist and the decision-maker, I identified five tools, lessons, and advantages a historical approach might provide to a policy-maker.

First, history allows us to understand the vertical origins of an event, and to identify and better understand the differences and interactions between long-, medium-, and short-term causes, or what John Lewis Gaddis (2002: 95) terms the immediate, the intermediate, and the distant. This is an obvious lesson – to understand where you are, you have to understand where you came from. But even constructing that narrative involves making important choices about causality and what matters in the world, choices that should be examined rigorously.

First, history sensitizes us to what may appear important in real time but has few long-term consequences, and vice versa. Once the important issues are identified, one can explore various temporal perspectives. A study of the origins of the First World War might, if it focused on shorter factors, concentrate on the failed diplomacy and provocative military plans that dominated events in July of 1914. Concentrating on medium-term causes would bring factors like shifting alliances or arms races into play. Long-term factors, including the dramatic demographic, socio-cultural, and economic forces reshaping Europe in the decades must have played an important role in the story. Which forces mattered more, and how did they interact? History can rarely answer those questions decisively, but undergoing such an exercise allows a decision-maker to challenge their assumptions about causality in ways that might lead to better policy. History can also illuminate the relationship between structure and contingency, which can be of enormous use to policy-makers wrestling with what factors they can change through policy and what they must accept.

Second, history helps the policy-maker recognize that historical understanding works over space, or horizontally, as well as over time, or vertically. In other words, few policy decisions can be isolated and cut off from other important, contemporaneous issues or concerns. A US decision on how to treat Iran's nuclear programme, for example, has second-order consequences on American policy towards a range of other countries and questions. Policy-makers understand this instinctively: A decision or a non-decision about a policy can have policy consequences for a range of related issues, with all sorts of second-order effects. Social science often tries to isolate a phenomenon, to study it in isolation from the complex connections it may have with the world around it.

Third, an understanding of the past sensitizes us to unintended consequences of actions. When Eisenhower approved financing for a massive damn in Afghanistan in the 1950s, he hoped to improve agricultural productivity in a developing nation, not make possible the creation of one of the world's largest opium fields. Nor did American leaders seek to lose a war in Southeast Asia to fully expose and take advantage of the Sino-Soviet spit. History reveals the wide gaps between intentions, actions, and consequences.

Fourth, history teaches decision-makers about something I call 'chronological proportionality', or the weight of historical events. The issues that most grab our attention today – and dominate the headlines of newspapers – are not likely to be the questions that have the most important long-term consequences. In 1967–68, American newspapers had far more print on the war in Vietnam than on the nuclear nonproliferation treaty, the Six-Day War in the Middle East, or the political changes in China and Eastern Europe, but what event mattered most to long-term US and global interests from our current perspective? Or consider historian Erez Manela's path-breaking working on US policy towards global efforts to eradicate smallpox during the same period. During the first seven decades of the twentieth century, 300 million people died of smallpox, twice the number killed by wars during the same period. In 1967, two million

people fell to smallpox; less than a decade later, the disease was eradicated. Manela (2010)[2] demonstrates how a combination of factors and actors came together, far below the level of high policy but still the result of discrete decisions, to generate policy outcomes that had profound global consequences that few recognized at the time or since. It is not always clear in real-time what matters most, though a historical sensibility can sensitize us to look for real-world consequences in unusual places.

Fifth, history conditions decision-makers to understand that policy decisions made in world capitals are often far less important in shaping what matters in the world than other, often less visible historical forces. Culture, technology, demographics, and geography, for example – all are critical forces that are less pliable to policy than we often think. These powerful but often unrecognized historical forces are the focus of my current book project – *California Dreaming: The 1970s and the Rebirth of American Power*. From the vantage point of Washington DC, there appeared to be little policy-makers could do to arrest the relative economic, military, political, and cultural malaise of the United States during that critical decade. Three events took place within a very short period of time: first, the sale of the early Apple personal computer; second, the release of Star Wars, the highest grossing motion picture of all time; third, the famous 1976 'judgement of Paris' where previously unknown wines from Napa Valley bested established French wines in a blind taste test. In other words, policy-makers in Washington in the mid-1970s, pouring over economic data, looking at crime statistics and urban crisis, witnessing political chaos abroad, and fearing a Soviet military behemoth that appeared to be winning the arms race, had little reason to be optimistic about the future. But the future was being made elsewhere and in different ways than policy-makers understood, in places like California, where deep and often obscure historical forces were working to transform the United States economy, society, technological base, and culture in ways that would have profound effects on American power and world history.

History and complexity: warnings, cautions, and insights

While these five historical concepts are useful, they are not especially profound or original – which is part of their appeal and power. Most decision-makers understand that there are short-, medium-, and long-term causes, or that their decisions have unintended consequences and that the world is shaped by many factors beyond the influence of simple policy interventions. Can a historical sensibility provide even more insight for policy-makers? Can the lessons of the past go beyond the obvious, to provide even sharper lenses for Zelikow's microscope? I believe it can. The final four 'tricks of the trade' might be thought of less as 'tools' or lessons than warnings, cautions, and guides to navigate the complex landscapes of the past, which are often full of shadows and false routes, while offering ways to apply these lessons to the present and future. Understanding these cautions and insights may allow for historical work to

be used more effectively to engage large public questions. They may also soften some of the ethical and political concerns that often prevent historians and policy-makers from deeper engagement.

The sixth insight historical sensibility should allow for is a rigorous 'stress-testing' of historical analogies. Every policy-maker uses analogies from the past, although they often do it in overly simplistic or misguided ways. May and Neustadt convincingly argued that teaching policy-makers to vigorously examine these analogies was a lot like teaching sex education to teenagers. Since, regardless of what you say or do, teenagers are going to have sex and policy-makers are going to borrow analogies from the past, at least they should do so safely and with some enjoyment. Or as John Gaddis (2002: 9), inspired by Machiavelli, states, 'we're bound to learn from the past whether or not we make the effort, since it's the only data base we have', so 'we might as well try to do it systematically'.

When interrogating analogies, it is important to remember that events from the past often produce distinct and contradictory lessons and analogies, which can be used in more than one way. James Steinberg (2016: 237–52) – looking at the policy process towards the Balkan crisis in the 1990s – demonstrates how the same historical event meant different things to different people and governments, and provided contrasting historical lessons. This does not surprise historians – we are comfortable that the study of the past provides little consensus and is full of contradictions – but this insight should force consumers of historical analogies to test their own assumptions and avoid seeking self-confirming evidence from the past. As Eliot Cohen (2005: 579) wisely suggests, a historical sensibility should view analogies 'with grave suspicion because it is exceptionally sensitive to context; it looks for uniqueness much more than commonality'. Steinberg argues there are three steps to developing and testing a historical analogy: collecting evidence and facts, developing a historical interpretation, and comparing and contrasting competing analogies and interpretations. Steinberg correctly suggests that decision-makers do not focus as much as they should on the third task. The careful use of historical counterfactuals can be useful in such an exercise (Gavin 2015).

Seventh, a deep historical perspective should allow the decision-maker to avoid outcome or retrospective bias, or fall into the trap of what I call 'understanding the Third Balkan War'. We study, argue, and even obsess over the July 1914 crisis largely (and understandably) because of the horrors that followed: a catastrophic and largely senseless world war that killed countless millions and unleashed years of radical revolution, pandemics, genocide, economic disaster, and a second, even more bloody world war. We look at the folly of July 1914 through the horrific aftermath that we still live with. But that is not how policy-makers living at the time thought about it – they had no idea what the future held. We often forget that they had gone through numerous political crises in the decade before and had escaped without danger or global conflagration. When crises did lead to conflict, the wars were localized – the first and second Balkan Wars. While some policy-makers dreaded and feared the worst, many in

July 1914 thought a war would be short or even localized – a Third Balkan War. That they were tragically wrong does not remove our responsibility as historians and decision-makers to better understand how they viewed the world, and to not interpret their actions and policies through the lens of the horrors that were to follow (horrors which surely would have given them pause).

As former National Security Advisor Sandy Berger pointed out, 'History is written through a rear-view mirror but it unfolds through a foggy windshield' (Wall Street Journal 2004). The past should be used in a way that avoids 'the curse of knowledge', or the cognitive bias that emerges when, in hindsight, we wrongly believe that a historical outcome was more predictable than was likely the case. Since we know how past events have turned out, we can easily assume that the causal path that led to the event was inevitable. But most complex and difficult policy choices involve what former Secretary of State Henry Kissinger has called '51/49' decisions: In other words, it is very difficult to know, a priori, whether a difficult policy choice will turn out correctly, even if in retrospect it seemed obvious. This is true for good policies as well as bad. Few observers or even participants would argue that the process the Obama administration undertook to rid Syria of chemical weapons in the summer of 2014 was anything close to ideal, even if the outcome may have been a good one. By the same token, an ideal process can easily lead to undesirable outcomes. Factors such as luck or bad weather can derail the best-laid plans, as Phillip II of Spain could have attested.

This point relates to why we should be careful not to cherry-pick events from the past or be unaware of horizontal connections, as mentioned above. During what Fred Logevall has called the 'long 1964', the Johnson administration made what was, in retrospect, a tragic and unwise decision to escalate the United States role in the war in Southeast Asia. Looked at both in hindsight – we know the outcome – and in isolation – just focusing on American policy in Southeast Asia – President Johnson and his advisors look inept. At the same time, however, the same administration carried out an impressive debate and discussion of how to respond to what was seen as a far greater long-term danger – the Peoples' Republic of China's detonation of an atomic device in October 1964. This process led to a sophisticated and successful nuclear nonproliferation policy that resulted in the 1968 Nuclear Nonproliferation Treaty and established the principles that guide US policy to this day. Did the same people who crafted these complex strategies simply lose 20 IQ points when the discussion turned to Vietnam? In fact, making policy in real time is extraordinarily difficult, and history should avoid simplistic judgements based solely on future outcomes that could not be anticipated.

By the same token, historical thinking can help the analyst avoid what I call the fallacy of the last out. We've all seen a baseball game where the outcome is decided by a hit with two outs in the ninth, or a football game that is decided by a missed field goal in the last seconds of the game. The natural temptation is to engage in a counterfactual exercise that changes the last, most visible variable or event – striking out or making the field goal – to produce a different outcome.

This is similar to scholars who obsess over a missed telegram in the last days of the July 1914 crisis. These events matter, of course, but focusing too much on them may obscure the larger causal story driving events. A run scored in the fourth inning or a field goal missed in the first half matters as much to the final score, but we are less likely to study what generated those outcomes.

The eighth insight that emerges from a deep historical awareness is an understanding that while time unfolds in a linear manner, history, the causal changes from the past that we care about, often do not. The biologist Stephen J. Gould originated the hypothesis that evolutionary development does not unfold in a linear, arithmetic manner, but is instead marked by isolated episodes of rapid speciation between long periods of little or no change. While much of history unfolds in a gradual manner, some phenomena explode onto the scene in a manner that 'accelerates' history. In other words, for some of the causal phenomena we care about, there might what might be thought of as a 'velocity' of history, where under certain conditions things move exponential faster than in more stable times. After the start of the First World War in 1914, for example, politics, both domestic and international, changed faster and in more dramatic ways than ever before. Important aspects of European history may have been in the biological equivalent of *stasis*, with slow and linear changes in the century after the Congress of Vienna, but what might be seen as *speciation*, or new forms of revolutionary politics, war, and culture, exploded onto the scene in the years after 1914. The political revolutions in Europe in 1989 might be thought of in a similar way. C. Vann Woodward, explaining why James McPherson's monumental history of the US Civil War was both the longest volume in the Oxford History of America series while chronicling the shortest period, makes this point clearly:

> Precious little correlation exists between the importance, complexity, and abundance of historical events and the length of the time it takes for them to occur. Some history of momentous consequence requires centuries to unfold, while history of comparable importance can take place with staggering speed.
>
> (Van Woodward 1989: 1)

History helps policy-makers recognize that not all periods and events unfold at the same velocity or with the same complexity and consequence.

This awareness that history is not linear can provide two further insights to understand the contemporary world. First, an engagement with the past can actually help one better 'escape' the past, or recognize when an event or phenomena is actually new, with little historical precedent. There is very little the Crimean or War of Jenkin's Ear can tell us about thermonuclear weapons and how they transform issues of war and peace and world politics. There are times that history does not repeat itself and the world does produce something new. Consider the role that oral contraceptives had in transforming the standing of women; arguably, this safe, modern technology to control their reproductive

cycles allowed women to escape long-standing political, socio-cultural, and economic burdens and utterly transform their role in the world. Or consider the rise of political and even cultural tolerance for people of different experiences and backgrounds more generally, regardless of gender, race, or sexual orientation. While there are certainly antecedents, one might argue that the acceptance of human diversity (and the recent national and global backlashes against it) is relatively unprecedented in human history. Transformative technologies, profound normative changes, economic and political revolutions – a historical sensibility better prepares the policy-maker to recognize what is 'old wine in new bottles' and what is truly unprecedented.

Recognizing history is not always linear provides another insight – awareness of the history of things that did not happen or that may be hard to measure or assess. Political scientists call this 'selection effects'. Consider the almost complete disappearance of the horror of mass mobilized, great power wars of conquest in the eight decades after the Second World War. Many analysts attribute this to the power of nuclear deterrence. Few if any political goals are worth the risk of receiving a nuclear response in response to invading a foe with atomic weapons. To understand the history of the post-war years, we are largely interested in the history that *did not* happen – great power war. In other words, to understand post-war peace, we have to understand nuclear deterrence, which means we have to understand the history of things that did not happen that might have otherwise occurred in a non-nuclear world. This is extraordinarily difficult, if not impossible to do. Furthermore, the characteristics we believe shaped and helped nuclear deterrence succeed – fear, uncertainty, resolve, and credibility – are hard to measure in an individual, to say nothing of a state or an international system.

Finally, a historical sensibility conditions the observer to recognize perspective. We know that it is important to understand how others view and understand the past. But there is also a temporal aspect to perspective. Imagine a country that possessed the world's eighth or ninth largest economy, which was politically dominated by its aggressive military and surrounded by seemingly insurmountable security challenges. Let's say you told the leaders of that country – follow the grand strategy I suggest, and in a very short period of time, from a historical perspective, you will possess the world's second largest economy, built on a thriving technological base, be relatively secure, and develop a healthy democracy and a civic culture that was largely pacifistic. A country would have to be crazy to pass up that deal, but it effectively describes a nation – Japan in 1940 compared to 1970 – that pursued a disastrous war that left its country in ruin. Or imagine this exercise – a publisher provides a scholar with 300 pages to write the history of the world between 1945 and 1990. Even though the subject and end date would remain the same, we can easily imagine the book chapters might look much different when revised in 2000, 2020, or 2045, than it would when originally published in 1990. History reveals that how you assess the past does not only involve who is involved, but when the question is asked.

Perspective also encourages the policy-maker to challenge their assumptions and constantly revise their understanding of the past. Many things we believe to be true are not. Consider the story of Ty Cobb. Baseball fans recognize Cobb as the greatest hitter who ever lived, but they also grew up with stories of his mean-spiritedness, cheating, violence, and racism, hated by his fellow baseball players. This image was repeated in various forums over the years and accepted as gospel truth, until Charles Leerhsen started researching a biography and soon recognized that the received wisdom was completely wrong (see Leerhsen 2016a, 2016b).[3] It turns out Cobb was an avid student of history descended from a long line of abolitionists who enjoyed acting on the stage. While he was a passionate and aggressive ball-player, Cobb was well respected and liked by his contemporaries, and demonstrated a racial sensitivity unusual for the age. Leehrsen highlights why the myth of the terrible Cobb emerged – an unscrupulous biographer Al Stump simply made up sensational stories to sell books – and why it persisted for decades. 'It is easy to understand why this is the prevailing view. People have been told that Cobb was a bad man over and over, all of their lives. The repetition felt like evidence' (Leerhsen 2016b).

Conclusion

The renewed interest in using history as a guide to policy is welcome. It should be pursued, however, with caution. It sits awkwardly but proudly between the humanities and the social sciences. History provides few 'off the shelf' lessons, makes no predictions, and resists easily generalization. It is better at demonstrating what an event or phenomena *is not* than identifying what it is. History is as likely to be misused than provide lessons, and it often resists efforts to become 'applied'. Compared to its other, more muscular cousins in the social sciences, history can look anemic. 'Unlike sociology, political science, psychology, and the other social sciences, which tend to breed confidence in managing the future, history tends to inculcate skepticism about our ability to manipulate and control purposefully our destiny' (Wood 2009: 14).

Historians are also strange people, very different from policy-makers, at times intellectually chaste and at others times wildly promiscuous. Chaste in their obsession to uncover ever last shred of evidence, no matter how small or seemingly insignificant; promiscuous in their ability to create whole worlds and civilizations on the written page largely from their imaginations. What other avocation could obsessively fight over the precise timing of a telegram sent between two political leaders on the eve of war in 1914 but boldly and out of thin air name and define whole historical periods? It is easy to forget that categories such as the Middle Ages or the Renaissance or the Modern World do not exist in nature but are instead the creative result of the historian's imagination, or that the very concept of a 'French Revolution' was not solidified until established by historians almost a half-century after the event (Schama 1989: 7). Bringing this world of history together with policy is not easy or natural.

I would never suggest, however, that the effort is not worth it. History's gift of perspective, insight, empathy, and humility are powerful tools for statecraft. History allows you to see, if not understand, the broader and more complex world in which events take place. As former Secretary of State and historian Henry Kissinger told an audience at Harvard, the 'knowledge of history was essential for grasping the broader political context in which decisions must be made' (Walt 2012). Kissinger is absolutely right that 'a grounding in history as essential for understanding how different people see the world, and also for knowing something about the limits of the possible' (Walt 2012). It was crucial that 'one should study history in order to see why nations and men succeeded and why they failed' (Allison 2015). The complexity of world politics, according to the former Secretary of State, demands that the United States and its leaders 'operate within the attainable and to be prepared to pursue ultimate ends by the accumulation of nuance' (Kissinger 2009) . The accumulation of nuance is one thing historians do especially well. If nothing else, policy-makers learning the history of other nation's may be an inexpensive way of avoiding future mistakes. As John Jay observed in Federalist Number 5, 'the history of Great Britain is the one with which we are in general the best acquainted, and it gives us many useful lessons. We may profit by their experience without paying the price which it cost them.'[4]

Like all things worthwhile, however, this blend of history and policy is not easily achieved nor will it be a magic elixir. Knowledge is no guarantee of success; the double firsts Sir Anthony Eden earned in Persian and Arabic while at Oxford did not prevent him from pursuing disastrous policies towards Iran and Egypt when he was the prime minister of Great Britain. History can offer lessons, insights, and even methods, though they are often meager and must be used cautiously and with care. The most important quality of a historical sensibility, the most valuable gift provided by an immersion in the past, is humility. From the world of social science, where bold predictions and generalizations are the realm of the coin, and from the universe of policy-makers, where difficult choices demand clear answers and decision can have enormous consequences, this may not seem like much. Perhaps that is the point – making difficult decisions facing complexity and the radical uncertainty of the future is very hard (Gavin and Steinberg 2012). Even the best ideas will only help so much, though given the stakes, even those marginal improvements are well worth seeking. Perhaps it is helpful to remember the words of Sir Michael Howard (1981: 14), paraphrasing Jacob Burckhardt: 'The true use of history, whether civil or military, is not to make man clever for the next time, it is to make him wise forever.'

Notes

1 I am grateful to Erik Sand and Jim Steinberg for these insights.

2 A key element was the Johnson administration's decision, as part of an effort to improve its global standing during the Vietnam War, to accept the Soviet Union's offer to cooperate on the World Health Organization's smallpox eradication programme (SEP). But far more was involved than simply high policy:

> But the history of the SEP is more than just a story of interstate relations, and writing it into Cold War history requires us to adopt a broader conception of international society, one that combines attention to state actors with recognition of the role played by international organizations, nongovernmental organizations (NGOs), multinational corporations, and transnational 'epistemic communities' that produce, circulate, and deploy expert knowledge.
>
> (Manela 2014)

3 For a more recent version of how one must read even accomplished biographers very carefully, see Inboden (2016).
4 I am grateful to Will Inboden for this insight.

References

Allison, G. (2015) 'The Keys to Henry Kissinger's Success', *The Atlantic*, 27 November. Online. Available: www.theatlantic.com/international/archive/2015/11/kissinger-ferguson-applied-history/417846 (accessed 18 July 2019).

Barzun, J. (1974) *Clio and the Doctors: Psycho-History*, Chicago: Quanto-History and History.

Carr, E. H. (1961) *What is History?*, Cambridge: Cambridge University Press.

Cohen, E. (2005) 'The Historical Mind and Military Strategy', *Orbis* 49(4): 575–88.

Frank, J. (2015) 'Hilary Clinton's Baffling Foreign Policy Problem', *The New Yorker*, 30 December. Online. Available: www.newyorker.com/news/daily-comment/hillary-clintons-baffling-foreign-policy-problem (accessed 18 July 2019).

Gaddis, J. L. (2002) *The Landscape of History: How Historians Map the Past*, New York: Oxford University Press.

Gavin, F. J. (2007) 'History and Policy', *International Journal* 63(1): 162–77.

Gavin, F. J. (2015) 'What If? The Historian and the Counterfactual', *Security Studies* 24(3).

Gavin, F. J. and Steinberg, J. B. (2012) 'Mind the Gap: Why Policymakers and Scholars Ignore Each Other, and What Can be Done About it?', *Carnegie Reporter*, Spring 2012. Online. Available: https://teaching-national-security-law.insct.org/wp-content/uploads/2012/07/Carnegie-Corporation-of-New-York%C2%A0Mind-the-Gap.pdf (accessed 28 January 2020).

Gilbert, F. (1970) *The End of the European Era: 1890 to the Present*, New York: Norton and Company.

Graham, A. and Ferguson, N. (2016) 'Why the US President Needs a Council of Historians', *The Atlantic*, September. Online. Available: www.theatlantic.com/magazine/archive/2016/09/dont-know-much-about-history/492746 (accessed 18 July 2019).

Horowitz, M. (2015) 'What is Policy Relevance', *War on the Rocks*, 17 June. Online. Available: https://warontherocks.com/2015/06/what-is-policy-relevance (accessed 18 July 2019).

Howard, M. (1981) 'The Use and Abuse of Military History', *Parameters, Journal of the US Army War College* 11(1): 9–14.

Inboden, W. (2014) 'Statecraft, Decision-Making, and the Varieties of Historical Experience: A Taxonomy', *Journal of Strategic Studies* 37(2): 291–318.

Inboden, W. (2016) 'It's Impossible to Count the Things Wrong with the Negligent, Spurious, Distorted New Biography of George W. Bush', *Foreign Policy*, 15 August. Online. Available: https://foreignpolicy.com/2016/08/15/its-impossible-to-count-the-things-wrong-with-the-negligent-spurious-distorted-new-biography-of-george-w-bush (accessed 18 July 2019).

Kissinger, H. A. (2009) The Chance for a New World Order, *New York Times*, 12 January. Online. Available: www.nytimes.com/2009/01/12/opinion/12iht-edkissinger.1.19281915.html (accessed 28 January 2020).

Kuklick, B. (2006) *Blind Oracles: Intellectuals and War from Kennan to Kissinger*, Princeton: Princeton University Press.

Leerhsen, C. (2016a) *Ty Cobb: A Terrible Beauty*, New York: Simon and Schuster.

Leerhsen, C. (2016b) 'Who Was Ty Cobb? The History We Know That's Wrong', *Imprimis*, March. Online. Available: https://imprimis.hillsdale.edu/who-was-ty-cobb-the-history-we-know-thats-wrong (accessed 29 January 2020).

MacMillan, M. (2009) *Dangerous Games: The Uses and Abuses of History*, New York: The Modern Library.

Manela, E. (2010) 'A Pox on Your Narrative: Writing Disease Control into Cold War History', *Diplomatic History* 34(2): 299–323.

Manela, E. (2014) 'Globalizing the Great Society: Lyndon Johnson and the Pursuit of Smallpox Eradication', in F. Gavin and M. Lawrence (eds) *Beyond the Cold War: Lyndon Johnson and the New Global Challenges of the 1960s*, Oxford: Oxford University Press, 165–81.

May, E. (1973) *Lessons of the Past: The Use and Misuse of History in American Foreign Policy*, New York: Oxford University Press.

McPherson, J. M. (2003) *Battle Cry of Freedom: The Civil War Era*, Oxford: Oxford University Press.

Schama, S. (1989) *Citizens: A Chronicle of the French Revolution*, New York: Vintage Books.

Steinberg, J. B. (2016) 'History, Policymaking, and the Balkans: Lessons Imported and Lessons Learned', in H. Brands and J. Suri (eds) *The Power of the Past: History and Statecraft*, Washington, DC: Brookings Institution Press.

Taylor, A. J. P. (1963) 'Mistaken Lessons from the Past', *The Listener*, 6 June.

Van Woodward, C. (1989) 'Introduction', in J. M. McPherson (ed.) *Battle Cry of Freedom: The Civil War Era*, Oxford: Oxford University Press.

Wall Street Journal (2004) 'Transcript of Testimony of Sandy R. Berger', *Wall Street Journal*, 24 March. Online. Available: www.wsj.com/articles/SB108015599618064350 (accessed 18 July 2019).

Walt, S. M. (2012) 'What Henry Told Harvard', *Foreign Policy*, 12 April. Online. Available: https://foreignpolicy.com/2012/04/12/what-henry-told-harvard (accessed 18 July 2019).

Wood, G. S. (2009) *The Purpose of the Past: Reflections on the Uses of History*, London: Penguin Books.

Zelikow, P. (2015) 'The Nature of History's Lessons', in H. Brands and J. Suri (eds) *The Power of the Past: History and Statecraft*, Washington, DC: Brookings Press, 282–3.

Zenilman, A. (2007) Historian: Bush Use of Quote 'Perverse', *Politico*, 23 August. Online. Available: www.politico.com/story/2007/08/historian-bush-use-of-quote-perverse-005499 (accessed 18 July 2019).

6 From predicting to forecasting

Uncertainties, scenarios, and their (un-)intended side effects

Myriam Dunn Cavelty

'Risk and uncertainty are the hallmark of world politics at the dawn of the twenty-first century', writes political scientist Michael J. Williams (2008: 58). Indeed, major surprises such as the terror attacks on 9/11, the financial crisis of 2008, or the nuclear disaster in Fukushima in 2011 have enhanced the political significance of 'unknown unknowns', 'low probability high impact events', 'black swans', 'ruptures', 'shocks', or 'tipping points'. All of these concepts signify that the future bears unexpected surprises – however much we might think we can know about it. With their prevalence in political thought comes a sustained fascination with and utilization of techniques for dealing with the future: so-called future methodologies.

There is an extensive literature giving advice on how to use different future methodologies and tools (e.g. Schwartz 1991; Bell 1997; Horton 1999; Voros 2003; Hideg 2007). In addition, a more specialized type of literature looks at the application of future methodologies in the public sector, with some works focusing on their concrete impact on bureaucratic and political processes (e.g. Georghiou and Keenan 2005; Da Costa *et al*. 2008; Volkery and Ribeiro 2009; Navah *et al*. 2013). Predominantly, this literature is based on the premise that the world has objectively become more complex and uncertain, but that the right use of the right tools and the collection of the right, and nowadays also *more*, data can reduce uncertainties and thereby lead to overall 'better', more informed policy-making (Cuhls 2003). Therefore, the literature focuses mainly on the mechanics of these tools, the *method*, and on the 'best practices' through which they should be applied, the *process*.

What the literature deals with less frequently, however, is the *context* in which future methodologies are employed in public policy writ large[1] and the assumptions about the future and its manageability that influence this use. In order to fill part of this gap, I turn to the following question in this chapter: What assumptions and expectations drive the application of future methodologies in public policy? More particularly, what can we learn from the most popular methods of future thinking about the expectations and beliefs in public policy with regards to the future and its manageability?

This addition to the literature is important because we know that specific cultural and political contexts give rise to particular forms of anticipatory practices

and modalities. In order to understand the possibilities and pitfalls of our own situation better, we should strive to gain more insights into the 'who, what, when, where, why, and how' of creating and assembling future knowledge. Starting from this basis, we can then strive to formulate strategies for the productive use of the right kind of future methodology in different contexts.

To answer the questions posed above, this chapter first looks at literature describing the socio-political context in which future methodologies are situated, paying particular attention to the multifaceted concept of 'risk' and its nemesis 'uncertainty', and how different scholars have described the rise and the impact of these concepts in politics. Risks are what *might* happen rather than what *is* happening – they are by definition situated in the future, as potentials rather than actuals. Therefore, any dealings with risks are automatically future-oriented; and knowing about the mere existence of risks may even create a moral impetus to act.

When comparing the various ways in which these risks can be analysed, ranging from quantitative approaches like fault-tree analysis to qualitative approaches like surveys or expert panels, it is noteworthy that the term 'scenario' is used with high frequency, yet in very diverse settings and methodologies (cf. Bradfield *et al*. 2005). Analysing this use in some more detail is the aim of the second part of this chapter. By clustering different ways of using scenarios, I identify two ideal-types of forward reasoning: *predicting* and *forecasting. Predicting* is done with the help of risk assessment, a backward looking method that relies on statistics to calculate the probabilities of an event. This is used in cases where uncertainty seems low, manageable, or unimportant. *Forecasting* on the other hand is based on narrative forms of imagining possible and desirable futures. It is used when uncertainty is foregrounded.

The third section of the chapter looks at the larger context of this use, linking knowledge creation processes to the politics of using knowledge. Interesting and somewhat paradoxical dynamics are revealed: Actors in public policy mainly strive for actionable, 'secure' knowledge by using prediction methodologies and neglecting or sidelining forecast methodologies, but they also know quite well that the results obtained from predicting are much higher in uncertainty than the methodologies suggest. Therefore, they start acting accordingly: by managing the risks of being wrong about risks. This is also evident in the rise of the concept of 'resilience', which is focused on optimally coping with any kind of adverse event, without attempting to predict them. However, since the need to base policy decisions on a robust scientific basis will certainly not disappear, there will always be a demand for matching the right method and practice to the specificities of the problem. A better mix between prediction and forecast methodologies based on contextual awareness would be a first step in the right direction.

The context: risk and its counter-concept uncertainty

In the larger socio-political and historical context of modernity, the multifaceted concept of 'risk' holds a prominent position as a concept linking the

presence to the future (Althaus 2005; Aven 2012). The concept belongs to a 'family of ways of thinking and acting, involving calculations about probable futures in the present followed by interventions into the present in order to control that potential future' (Rose 2001: 7). Emerging as a powerful secular alternative to religious visions of fate, risk comes with a quasi-ideological belief in the possibility and even obligation to optimize the future (cf. Giddens 1991; Bernstein 1998; Garland 2003). The methodologies that are in use to classify, quantify, and to some extent predict aspects of the future are then fundamentally this: decision-support tools.

Because of its essential role as a concept to describe our relationship to the future, risk as 'social technology' (Aradau *et al*. 2008) has been linked to the internal organization of societies – and by extension the organization of the state and its bureaucracies – by various scholars (Ewald 2002; Giddens 1992; Beck 1992). In fact, for risk sociologists, different orders of society in recent history are both co-produced and legitimized by the way risks are generally believed to be locatable and calculable in these societies. Different types of risk thinking are reflective of the way futures are envisioned but also on how the future is seen to relate to the present. This includes questions of authority and power: Who has the power to know the future based on what kind of methods? Who decides what to do with this knowledge?

Given shifting contexts, the understanding of risk varies in time (Renn 1998). At all times, however, there is a clear link to its 'counter-concept': uncertainty. In his seminal work from the 1920s, Frank Knight defined risk as the 'known chance' (related to probability) and uncertainty as the 'unknown', which cannot be quantified the same way (Knight 1921: 245). In this view, rational behaviour can help us manage or even eliminate risks, whereby uncertainty refers to indeterminacy between the actions of today and the events of tomorrow. In this way, it is 'subject to a different rationality, based on norms and values and not on instrumental criteria' (Daase and Kessler 2007: 418). From this, uncertainty emerges as a different category of knowledge, even as a category of threat to rational decisions that is distinct from risk (Best 2008; Runde 1998). However, and importantly, since it is a distinct category, it can also be located and categorized, and on that basis, strategies for dealing with these uncertainties can be defined and employed. As a result, specific methodologies are deployed to 'identify, calculate, imagine, assess, prevent, compensate and mitigate the uncertainty' (Aradau *et al*. 2008: 150; similar thoughts also in Aradau and van Munster 2011).

Depending on how high relevant actors in the policy process judge the uncertainty or the level of unknowability to be, different future methodologies will be employed. The point here is not whether risks have objectively changed (like Ulrich Beck and others claim)[2], or whether they are more abstract, complex, or global today than before (Handmer and James 2007: 120). Rather, the point is that depending on what people think they know and can know about a specific issue, they will use different approaches to get further knowledge about it. Different approaches that they can choose from are distinguished by how well

they deal with what is known or knowable – and what is not known and not knowable. The use of different future methodologies is therefore an indication of particular prevalent logics concerning risk and uncertainty.

The practice: predicting vs. forecasting

Among the technologies to map and visualize possible futures, planning based on some form of 'scenarios' represents a very popular approach in the realm of policy-making. In a very general sense, a scenario postulates a sequence or development of events in the future. However, there are two fundamentally different types of scenarios found in the future-oriented practices of public policy agencies, based on how much uncertainty they foreground: The first type of scenarios is used in risk assessment practices, which is then typically used as an input for contingency planning. Here, I call this *predicting*. The second type of scenarios is used to depict possible future situations in a narrative way, used more often as a basis for the development of long-term strategies. Here, I call this *forecasting*. The first eclipses uncertainty almost completely, whereby the second highlights, even embraces it. In this chapter, both types are discussed separately with a third subsection summarizing the differences.

Type 1: scenarios for predicting

The first type of scenarios is used in the context of risk assessment, systematic processes that include risk identification and evaluation but also mitigation and monitoring (cf. Aven 2009). In public policy, these scenarios can be found in so called national 'risk registers', documents describing a collection of major risks across different issue-areas that are relevant to a given country (Hagmann and Dunn Cavelty 2012).[3] These scenario collections, that, for example, use categories like 'natural hazards', 'major accidents', or 'malicious attacks' to cluster risks (cf. Cabinet Office 2015), aim to represent issues of concern as broadly as possible, in order to be able to prioritize and streamline policy responses across areas of responsibilities and agencies.

These kind of scenarios are about reducing uncertainties and about making risks comparable. The latter happens by virtue of two elements: A general formula for how to calculate risks, and clear definitions of how the elements of this formula are to be measured. Subtle variations and add-ons notwithstanding, risk is usually represented by the likelihood (of an event's occurrence) multiplied by its impact (the harm that it creates). Following what is generally known as 'insurance logic', this ultimately allows for the monetization of damage (Hagmann and Dunn Cavelty 2012). However, in the case of risk register – that always deal with risks of a magnitude that has importance for a whole country – neither strictly qualitative nor quantitative methods suffice to get the data for the two categories likelihood and impact. In instances where historical data is available, as in the case of natural catastrophes or technical risks, there is strong reliance on statistics. Elsewhere, and in assessments of

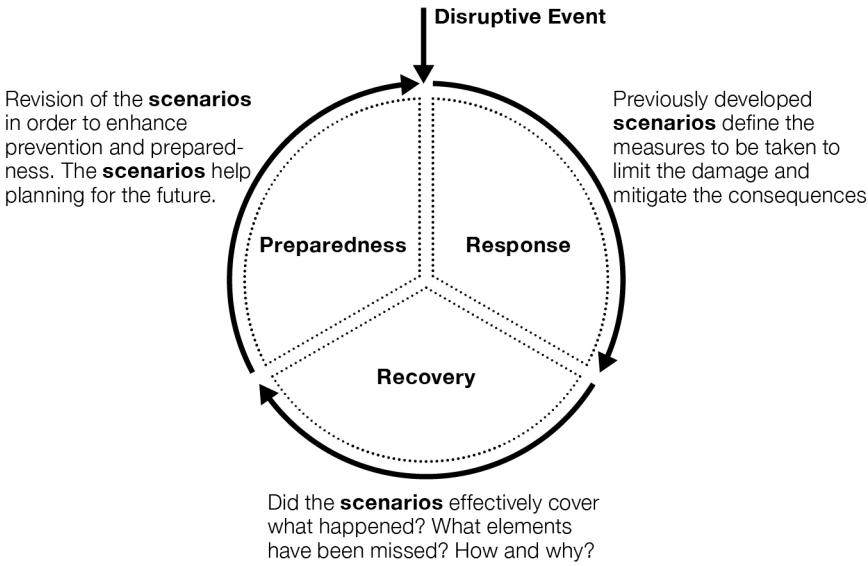

Figure 6.1 Use of scenarios in the risk assessment cycle.

societal and political risks in particular, qualitative assessments of past occurrences are made, extrapolated, and projected into the future. Often, expert panels are used for risk estimation (this is the so-called Delphi method, see Hsu and Sandford 2007).

Scenarios play a role in all three core phases of risk assessment and management: preparedness, response, and recovery (see Figure 6.1). In addition, scenarios are often used as training instruments to help public services practise effective emergency coordination (see also Anderson 2010).

The central role of these scenarios is not to debate what endangers popular well-being and what does not, but to make comprehensive information about all kinds of potential dangers available and comparable and, in the process, to make political programmes actionable in the tradition of an 'all-hazards approach' (Heng 2006a; 2006b).

Type 2: scenarios for forecasting

The concept of risk and risk management implies manageability of the future based on linearity and extrapolation from past experience, a world in which 'bell-curved distributions of probabilities and outcomes' are the rule (Jervis 2009: 477) and where invisible (and/or non-linear) outcome generators, complex payoffs, fat tails, or non-scalable probability distributions are the exception (Blyth 2009: 453). While this assumption is very prevalent in public policy, recent major shocks with global implications have intensified the discussion

about the limits of the knowable and foreseeable, and, by implication, the limits of traditional planning methods like risk assessment.[4]

As a result, some government agencies have started to embrace a different type of scenario for planning (Habegger 2009), to try and become more attuned to the unknown or unknowable, in short, to develop techniques for how to deal with uncertainty.[5] In contrast to the issue-focused and event-focused scenarios for risk assessment, forecast scenarios consist of so-called 'internally consistent' stories about medium- to long-term futures. Scenarios of that variant are built step-by-step through structured, but innovative and creative, 'out-of-the box' thinking. Importantly, scenario planning is not a tool that claims to be able to predict future events or even get a better understanding of these contingencies. Rather, there is a strong focus on the process that enables engaging with different – as in plausible, possible, probable, or preferable – futures (Leigh 2003). Within that process, different other 'future methodologies' are used (for example, trend analyses). The overall aim is to help policy-makers to expand their thinking, to make better sense of changes in their external environment in order to spot so-called 'early warning signals', and to be attuned to conflicts between diverging societal interests and values to help finding common ground for future action (Volkery and Ribeiro 2009: 1199).

There are some common steps in every scenario building exercise. The most well-known methodology is the 'two axes method'. Generically, the following steps are taken in a collaborative process that tends to last several days:

- Question and time horizon of the scenario exercise is set (e.g. the EU in 2030).
- Drivers and trends relevant to this future are brainstormed (e.g. social cohesion, migration, economic performance, etc.).
- From a large set of such drivers, clusters (according to social, political, economic, cultural drivers, for example) are formed, and then the most relevant are selected in a group process.
- From this smaller group of drivers, two with high impact and high uncertainty (e.g. social cohesion and economic performance) are picked. These two build the scenario axes that are labelled with opposite developments (e.g. inclusion–exclusion; growth–stagnation) for four diverse scenarios (see Figure 6.2). Because the scenarios are built along factors with high uncertainty and with contrary developments, the set-up ensures that the four scenarios are as diverse as possible.
- For each of the scenarios, the characteristics are discussed in groups, and then the scenarios are developed into stories or narratives. Scenario 1 in this case would describe an EU in which economic growth and social inclusion are the key parameters, scenario 2 an EU where growth is still there, but social exclusion is prevalent, etc.

Forecast scenarios do not seek to reduce uncertainty – they are actually built on it. This methodology seeks to push the boundaries of knowledge away from

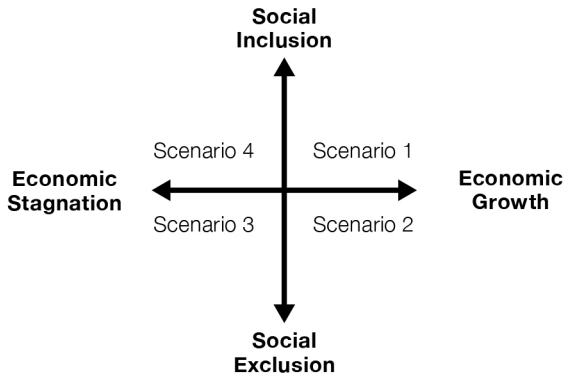

Figure 6.2 Two-axes method for four different scenarios.

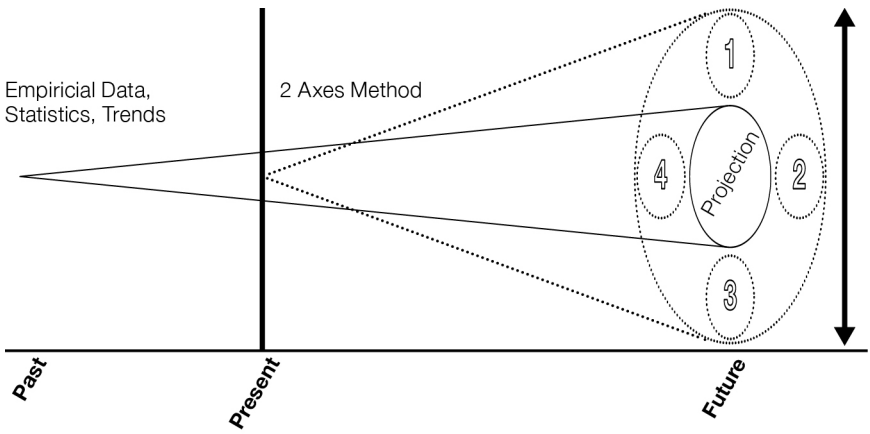

Figure 6.3 The futures cone.

mere projections of known trends based on statistics. Participants are told to be creative and think 'out-of-the box' when they describe the scenarios and actively go against well-established thought structures when they imagine themselves in these distant futures. This way, the so-called 'futures cone' is opened up as widely as possible (see Figure 6.3).

Due to the nature of the methodology and the type of 'knowledge' that is collected in the scenario process, the actual content of the future scenarios is secondary. They are considered mere illustrations of the future, understood as a basis for additional deliberations, such as strategy finding or strategy testing or, maybe most importantly, to identify desired futures and possible pathways towards them. They can still serve as decision-support, but because

no 'actionable knowledge', no certainty of the future, is produced, the full onus is on the people who make strategic decisions, based on the desirability of specific futures.

Predicting vs. forecasting: a typology

On the opposite ends of a spectrum, prediction and forecast scenarios may be presented perhaps a little crudely as two ideal type future methodologies that encapsulate fundamentally different aims (see Table 6.1). The first seeks to illustrate future adverse events as realistically as possible whereas the second aims to produce stories of possible futures that are plausible and internally consistent but not probable. Therefore, a crucial difference between the first and the second is the kind of knowledge sought to build them and concurrently the type of expertise that is used. In the first type, scenarios are understood as 'adverse event illustrations' and are thus based on 'secured' knowledge of experts, which relates to incidents that happened in the past. In the second, a group of usually diverse people is brought together in order to be creative and imaginative in the process of drafting visions of the future. While in this case, the aim is to push the limits of knowledge far beyond what can be projected into the future from the experience of the past, the first type of scenario aims to depict the events occurring as realistically as possible. In the first case, the confidence in 'secure' (and securable) knowledge is high; in the second, the uncertainty of the future is explicitly embraced.

In the next section, I turn to analysing what these foresight methodologies show us about the expectations and beliefs in public policy about the future and show what kind of influence they have in the policy process.

Table 6.1 Comparison between prediction and forecast (ideal-type)

	Type 1: Scenarios for prediction	*Type 2: Scenarios for forecasting*
Purpose	Illustration of a future adverse event and how it unfolds, as realistically as possible	Stories of possible futures, as plausible as possible
Content	Precise and accurate	Internally consistent, possible not probable
Method	Calculation of Likelihood × Impact Cost-benefit logic applies	Focus on step-by-step process of scenario building as discursive, deliberative process
Scope	Narrow: Focused on specific issues, e.g. earthquakes, pandemics, terrorist attacks	Broad: Focused on general trends and situations, e.g. Country A in the year 2030
Time	Not too far in the future, short-term	Quite far in the future, long-term

	Type 1: Scenarios for prediction	*Type 2: Scenarios for forecasting*
Uncertainty	Low: Confidence in secure knowledge is high	High: Confidence in secure knowledge is low
Type of knowledge	Science-based: 'Secure', experience-based knowledge (data, statistics)	Deliberative: Out-of-the box thinking, innovative, creative (good stories)
Type of expertise	Subject matter experts, specialists from government, academia, consultancy	Optimal mix of people, combination of experts and creative thinkers for group work from all parts of society, even lay persons
Used for (mainly)	Operative purposes: (Contingency) planning, input for and part of risk management process, development of Standard Operating Procedures	Strategic purposes: Development of long-term planning, to elevate sensitivity to uncertainty (early warning signs), open up future space for deliberation

Impact: the disconnect between prediction and decision

Scenarios for prediction build on the belief that parts of the future can be known and manipulated to our benefit with the help of risk management strategies. Scenarios for forecast on the other hand have benefits that are more indirect and mainly situated in the realm of perceptional change and awareness for future issues. Perhaps a little surprisingly, a series of roundtables as well as scenario exercises conducted with public policy officials from various countries[6] suggest that the use of Type 1 scenarios (predicting) is far more prevalent and accepted in public policy than Type 2 scenarios (forecasting).

The main reason why Type 1 scenarios have more traction in public policy is the scientific method used to calculate and rank risks based on a cost-benefit rationale. Furthermore, they suggest a high utility due to a direct link between these outputs and the policy-process. To serve as tools for decision-making, risks are visualized in terms of their impact and likelihood in so-called risk matrices (see Figure 6.4). There is a zone for low risks in the left bottom corner, an intermediate zone for medium and more significant risks, and a zone for very high or even extreme risks in the top right corner (Cox 2008). The left lower corner suggests that the issues are low priority or outright negligible, middle risks signify that they should be 'mitigated' under the ALARP principle (which stands for keeping risks 'as low as reasonably practicable'), and the top right corner means that these risks are unacceptable under the existing circumstances, requiring immediate action and risk avoidance at almost all costs (cf. Klinke and Renn 1999).

The use of scientific methodology empowers a modernist kind of 'truth speaking', whereby risk registers purport to define public insecurity in an

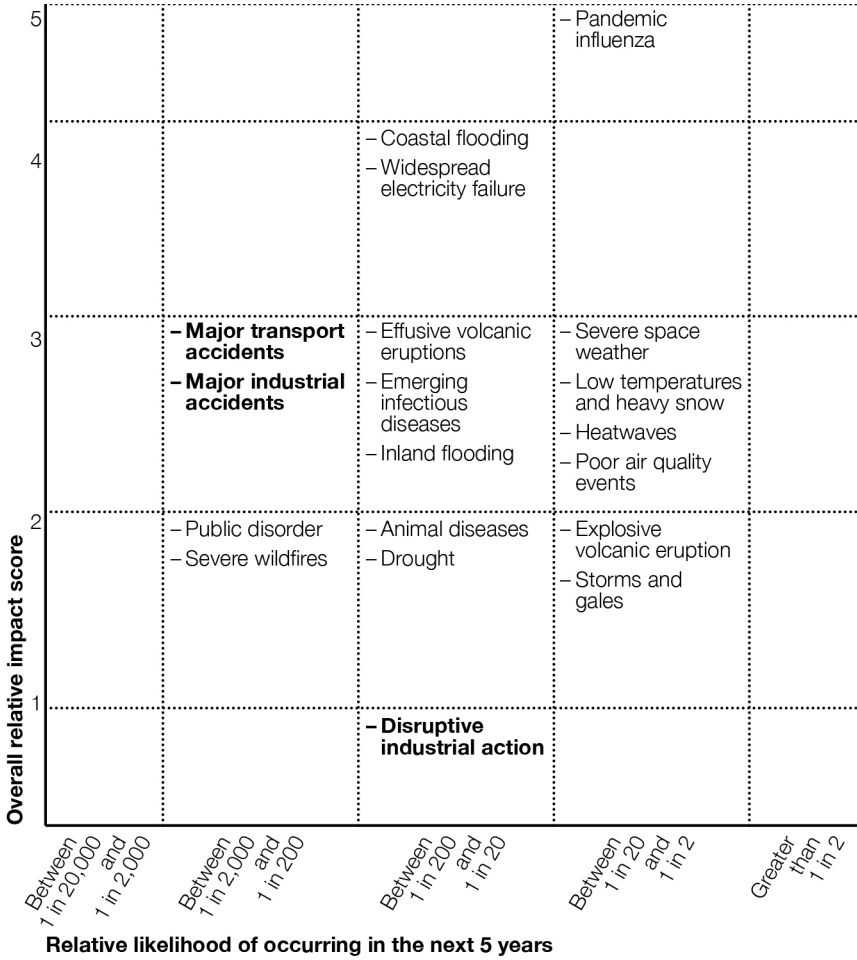

Figure 6.4 Example of a risk matrix, UK government.

objective, hence apolitical manner, suggesting they are of the same importance in politics to begin with and that potential government intervention should be based solely on scientifically calculated risk levels. There are two main issues with this. One, a closer look at the data reveals that Type 1 scenarios are not as scientific as the methodology purports. More often than not, data on natural hazards is incomplete and can therefore not provide detailed understandings of historical occurrences and damages (Bründel 2009). In the realm of social and political dangers, expert focus groups are the primary sources of knowledge, often very loosely based on the Delphi method. This means that informed subjective estimations, or peer-discussed agreements, function as the main data on certain risks. In many respects, Type 1 scenarios therefore rely on a patchwork of scientist/expert data rather than on secure scientific knowledge, with a very

high degree of uncertainty. What emerges from this is what Beck has called 'feigning of control over the uncontrollable' (Beck 2002: 41), whereby the confidence in knowledge vs. uncertainty is low, but everybody pretends it is not.

Two, by closing off decision space, risk matrices give power to bureaucracies and their technocratic risk assessment approaches, quasi-taking the political decisions, which are always based on values and beliefs as well as on scientific facts, out of decision-making and politics. At the same time, decision-support tools do not delegate decisions and they definitely do not delegate responsibility. By pretending uncertainty is not important, prediction cannot help with what Beck has termed the 'risk trap' (1999: 139–41), the deadlock between decision-making and uncertainty, arising from the fact that no-one knows the outcomes of decisions which still, however, have to be made. There is a double inertia arising from this: Despite the considerable amount of time and resources put into Type 1 scenarios in public policy, the temptation of a deliberate non-prioritization of risks, of 'non-action', is high. Yet, when risks materialize, people in charge are held accountable not only for their actions but also for their *non*-actions, especially when dealing with the acute phases of response and recovery. As a result, secondary risk management (Power 2004) becomes attractive. In secondary risk management, people in positions of authority manage the risk to their own (personal or institutional) reputation rather than the actual primary problem. One outcome is even more Type 1 scenarios – to prove in case of an incident that the necessary steps to prepare for a future contingency had been undertaken.

Beyond this inertia, the rather stellar rise of the concept of 'resilience' in many aspects of public policy is another indication for a low and waning belief in the manageability of the future, at least in the West. Within various policy fields, resilience has seemingly become an answer to a 'world of rapid change, complexity and unexpected events' (Chandler 2013: 1). Resilience is the ability of a system to recover from a shock, returning either to its original state or to a new, adjusted state. Therefore, the concept promises an additional safety net against large-scale, major, and unexpected events (Dunn Cavelty *et al*. 2015). As a concept, it accepts that disruptions or shocks are inevitable, even despite preventive measures against threats. This is a consequence of the concept of residual risk from risk management, which accepts that risks to an organization or to a country are never reducible to zero.

Resilience is positioned as an approach 'that foregrounds the limits of predictive knowledge and insists on the prevalence of the unexpected' (Walker and Cooper 2011: 147). While protective (and defensive) measures aim to prevent disruptions from happening and remain rooted in a world of risk and linear cause-effect relationships, resilience fully embraces unknowability and accepts that different kinds of disruptions are inevitable by nature. Resilience recognizes that the future is not approachable through linearity, but is different from the past, even radically so. As a result, the key to the future is to learn how to adapt in all kinds of situations. In that way, resilience is action-oriented without pretending to know the exact details about future events. Prediction, on the

other hand, is of marginal value, is even potentially problematic, because it focuses too much on single events and standard operating procedures, which then become part of the problem.

In contrast to the rationale behind Type 1 scenarios, embracing resilience means expecting the unexpected and accepting uncertainty. Clearly, this is where Type 2 scenarios can – or rather could! – develop maximum effect. If the future, or at least parts of it, is seen as uncertain, we have to develop better abilities to adapt to the unsuspected. In that way, adaptability is the antidote to unpredictability. Rather than seeing uncertainty as a threat, uncertainty can be positioned as a positive asset – it invites us to think about desirable, sustainable futures and how society, collectively, might get there.

Conclusion

Throughout human history, societies had different beliefs in the manageability and manipulability of the future. The concept of risk holds a prominent position at least since the dawn of modernity as 'social technology' that allows for a rational, controlled way to structure and prioritize decisions and actions taken today with regards to the future. However, this way of thinking represents a technocratic dream that has lost some of its shine. With the increased attention to 'shock events' in the last decades, the limits of the traditional tools for prediction, among them risk management, have become apparent. As a result, there seems to be a general disenchantment with the notion that the world is about regularity and predictability at all.

Yet, this chapter also speaks to a conundrum for policy-makers. They are expected to make decisions as if they knew what the future would bring, despite the fact that they know the future is uncertain, regardless of how much time and money they spend to try and reduce this uncertainty. This, then, results in unintended consequences with detrimental effects: They start managing the risk of being wrong about risk (while still keeping up the quest to find better ways to predict the future). Unproductively, this results in inertia because policy-makers start investing more into managing the risk to their reputation or status. More productively, this creates new types of governmental techniques like resilience, where resources are directed towards the ability to adapt and learn, rather than to know the future with certainty. Furthermore, it also means to share responsibility or renegotiate whose responsibility the challenges of the future are.

A destabilization of the belief that the future can be known opens up new possibilities for public policy. On the one hand, awareness of different tools for different problems can help manage expectations both internally and externally. The choice of method needs to be optimally and honestly matched with the goal of the future exercise and the object under scrutiny. Furthermore, to accept 'unknowability' means to accept that effective control and even manipulation of the future in many areas is beyond human ability. Such a reconceptualization could shift the attention towards the establishment of a

political discourse that embraces uncertainty and even failure. This opens up avenues for inclusive, interdisciplinary, and democratic forecasting exercises in many different areas of policy-making. Uncertainty is not a threat: It gives human agency to shape desired futures.

Notes

1 The chapter makes a high-level, general argument that does not pay attention to the existing differences between agencies or countries. The empirical data, observations, and experience with prediction/foresight mainly comes from the interaction with civil protection agencies and similar entities in Western Europe.
2 Ulrich Beck (1992, 1999) is well known for distinguishing between a first and second modernity and linking this to the understanding of 'risk'. He makes the point that in the second modernity, risks are different: Societies have increasingly become aware ('reflexive') of possible global catastrophes. This awareness, so his argument goes, has changed our perception of the origins of risks, of their manageability, and of the responsibility linked to reducing them.
3 Countries with such risk registers, to name just a few, are the Netherlands, the UK, the US, Ireland, and Switzerland.
4 There also is a lot of literature on how to 'fix' risk assessment to make it more uncertainty-proof (cf. Aven 2011, 2016).
5 Historically, forecast scenarios have a very strong link to defence planning (but are far less used in other governmental contexts). In the decades following World War II, the RAND Corporation pioneered the use of alternative futures/scenarios (Davis 1996: 48). These were geared towards helping policy-makers to develop a fuller picture of the uncertainties in the system, and to use strategies to shape defense policy accordingly (Leigh 2003).
6 CRN Roundtables on Comprehensive Risk Analysis and Management, see: www.css.ethz.ch/en/services/digital-library/series.html/96487. Also: 'Perspektiven 2025 – Lage- und Umfeldanalyse für die Bundespolitik', www.bundespublikationen.admin.ch/cshop_mimes_bbl/00/0024817F68691EE1BAD8E8F24D56D2EB.pdf.

References

Althaus C. E. (2005) 'A Disciplinary Perspective on the Epistemological Status of Risk', *Risk Analysis* 25(3): 567–88.

Anderson, B. (2010) 'Preemption, Precaution, Preparedness: Anticipatory Action and Future Geographies', *Progress in Human Geography* 34(6): 777–98.

Aradau, C. and van Munster, R. (2007) 'Governing Terrorism through Risk: Taking Precautions, (un)Knowing the Future', *European Journal of International Relations* 13(1): 89–115.

Aradau, C. and van Munster, R. (2011) *Politics of Catastrophe: Genealogies of the Unknown*, London: Routledge.

Aradau, C., Lobo-Guerrero, L. and van Munster, R. (2008) 'Guest Editors' Introduction', *Security Dialogue* 39(2–3): 147–54.

Aven, T. (2009) *Risk Analysis*, Chichester: Wiley.

Aven, T. (2011) 'Selective Critique of Risk Assessments with Recommendations for Improving Methodology and Practice', *Reliability Engineering and System Safety* 96: 509–14.

Aven, T. (2012) 'The Risk Concept – Historical and Recent Development Trends', *Reliability Engineering and System Safety* 99: 33–44.
Aven, T. (2016) 'Ignoring Scenarios in Risk Assessments: Understanding the Issue and Improving Current Practice', *Reliability Engineering and System Safety* 145: 215–20.
Beck, U. (1992) *Risk Society: Towards a New Modernity*, New Delhi: Sage.
Beck, U. (1999) *World Risk Society*, Cambridge: Polity Press.
Beck, U. (2002) 'The Terrorist Threat: World Risk Society Revisited', *Theory, Culture and Society* 19(4): 39–55.
Bell, W. (1997) *Foundations of Futures Studies*, New Brunswick: Transaction Publishers.
Bernstein, P. L. (1998) *Against the Gods*, New York: John Wiley & Sons.
Best, J. (2008) 'Ambiguity, Uncertainty, and Risk: Rethinking Indeterminacy', *International Political Sociology* 2(4): 355–74.
Blyth, M. (2009) 'Coping with the Black Swan: The Unsettling World of Nassim Taleb', *Critical Review: A Journal of Politics and Society* 21(4): 447–65.
Bradfield, R., Wright, G., Burta, G., Cairns, G. and van der Heijden, K. (2005) 'The Origins and Evolution of Scenario Techniques in Long Range Business Planning', *Futures* 37: 795–812.
Bründel, M. (2009) 'The Risk Concept and its Application in Natural Hazard Risk Management in Switzerland', *Natural Hazards and Earth Systems Sciences* 9(3): 801–13.
Cabinet Office (2015) *National Risk Register of Civil Emergencies*, 2015 edition. Online. Available: www.gov.uk/government/uploads/system/uploads/attachment_data/file/419549/20150331_2015-NRR-WA_Final.pdf (accessed 19 December 2019).
Chandler, D. (2013) 'Editorial', *Resilience* 1(1): 1–2.
Cox, L. A. (2008) 'What's Wrong with Risk Matrices?', *Risk Analysis* 28(2): 497–512.
Cuhls, K. (2003) 'From Forecasting to Foresight Processes: New Participative Foresight Activities in Germany', *Journal of Forecasting* 22: 93–111.
Da Costa, O., Warnke, P., Cagnin, C. and Scapolo, F. (2008) 'The Impact of Foresight on Policy-Making: Insights from the FORLEARN Mutual Learning Process', *Technology Analysis and Strategic Management* 20(3): 369–87.
Daase, C. and Kessler, O. (2007) 'Known and Unknowns in the "War on Terror": Uncertainty and the Political Construction of Danger', *Security Dialogue* 38(4): 411–34.
Davis, P. (1996) 'Analytic Methods', in B. Bradley (ed.) *50th Project Air Force: 1946–1996*, Washington, DC: RAND Corporation, 47–51.
Dunn Cavelty, M., Brunner, E., Giroux, J., Doktor, C. and Brönnimann, G. (2011) 'Focal Report 5: Using Scenarios to Assess Risks', *CRN Report*, Zurich: Center for Security Studies (CSS).
Dunn Cavelty, M., Kaufmann, M. and Kristensen, K. S. (2015) 'Resilience and (In)security: Practices, Subjects and Temporalities', *Security Dialogue* 46(1): 3–14.
Ewald, F. (2002) 'The Return of Descartes's Malicious Demon: An Outline of a Philosophy of Precaution', in T. Baker and J. Simon (eds) *Embracing Risk*, Chicago: Chicago University Press, 273–301.
Garland, D. (2003) 'The Rise of Risk', in R. Ericson and A. Doyle (eds) *Risk and Morality*, Toronto: University of Toronto Press, 48–86.
Georghiou, L., and Keenan, M. (2005) 'Evaluation of National Foresight Activities: Assessing Rationale, Process and Impact', *Technological Forecasting and Social Change* 73(7): 761–777.
Giddens, A. (1991) *Modernity and Self-identity*, Cambridge: Polity Press.
Giddens, A. (1992) 'Risk, Trust, Reflexivity', in U. Beck (ed.) *Risk Society: Towards a New Modernity*, New Delhi: Sage.

Girard, J., Klein, D. and Berg, K. (2015) *Strategic Data-Based Wisdom in the Big Data Era*, Hershey, PA: IGI Global.

Habegger, B. (2008) 'Risk Management in Security Policy', *CSS Analyses in Security Policy* 3(30), Zurich: Center for Security Studies.

Habegger, B. (2009) *Horizon Scanning in Government: Concept, Country Experiences, and Models for Switzerland*, Zurich: Center for Security Studies.

Hagmann, J. and Dunn Cavelty, M. (2012) 'National Risk Registers: Security Scientism and the Propagation of Permanent Insecurity', *Security Dialogue* 43(1): 79–96.

Handmer, J. and James, P. (2007) 'Trust Us and Be Scared: The Changing Nature of Contemporary Risk', *Global Societ*y 21(1): 119–30.

Heng, Y.-K. (2006a) 'The "Transformation of War Debate": Through the Looking Glass of Ulrich Beck's World Risk Society', *International Relations* 20(1): 69–91.

Heng, Y.-K. (2006b) *War as Risk Management: Strategy and Conflict in an Age of Globalised Risks*, London: Routledge.

Hideg, É. (2007) 'Theory and Practice in the Field of Foresight', *Foresight* 9(6): 36–46.

Horton, A. (1999) 'A Simple Guide to Successful Foresight', *Foresight* 1(1): 5–9.

Hsu, C. and Sandford, B. (2007) 'The Delphi Technique: Making Sense of Consensus', *Practical Assessment, Research and Evaluation* 12(10): 1–8. Online. Available: http://pareonline.net/pdf/v12n10.pdf (accessed 19 December 2019).

Jervis, R. (2009) 'Black Swans in Politics', *Critical Review: A Journal of Politics and Society* 21(4): 475–89.

Klinke, A. and Renn, O. (1999) 'Prometheus Unbound: Challenges of Risk Evaluation, Risk Classification, and Risk Management', *Working Paper* 153, Stuttgart: Center of Technology Assessment.

Knight, F. (1921) *Risk, Uncertainty and Profit*, Boston, MA: Hart, Schaffner & Marx.

Leigh, A. (2003) 'Thinking Ahead: Strategic Foresight and Government', *Australian Journal of Public Administration* 62(2): 3–10.

Navah, M., Versluis, E. and van Asselt, M. B. A. (2013) 'The Politics of Risk Decision-making: The Voting Behaviour of the EU Member States on GMOs', in M. B. A. van Asselt, E. Versluis and E. Vos (eds) *Balancing between Trade and Risk: Integrating Legal and Social Science Perspectives*, London: Earthsan, 128–46.

Power, M. (2004) *The Risk Management of Everything: Rethinking the Politics of Uncertainty*, London: Demos.

Renn, O. (1998) 'Three Decades of Risk Research: Accomplishments and New Challenges', *Journal of Risk Research* 1(1): 49–71.

Rose, N. (2001) 'The Politics of Life Itself', *Theory, Culture and Society* 28(6): 1–30.

Runde, J. (1998) 'Clarifying Frank Knight's Discussion of the Meaning of Risk and Uncertainty', *Cambridge Journal of Economics* 22(5): 539–46.

Schwartz, P. (1991) *The Art of the Long View: Planning for the Future in an Uncertain World*, New York: Doubleday.

Volkery, A. and Ribeiro, T. (2009) 'Scenario Planning in Public Policy: Understanding Use, Impacts and the Role of Institutional Context Factors', *Technological Forecasting and Social Change* 76: 1198–207.

Voros, J. (2003) 'A Generic Foresight Process Framework', *Foresight* 5(3): 10–21.

Walker, J. and Cooper, M. (2011) 'Genealogies of Resilience: From Systems Ecology to the Political Economy of Crisis Adaptation', *Security Dialogue* 42(2): 143–60.

Williams, M. J. (2008) '(In)Security Studies, Reflexive Modernization and the Risk Society', *Cooperation and Conflict* 43(1): 57–79.

Part III

Empirical perspectives across policy fields

7 Uncertainty and precariousness at the policy–science interface

Three cases of climate-driven adaptation

Maria Carmen Lemos and Nicole Klenk

Climate change adaptation is the process of adjusting to the anticipated or experienced adverse impacts of climate change (IPCC 2014). In the past three decades, the growing need for individuals, households, cities, and natural resource management systems, for example, to respond and adapt to weather and climate impacts has fostered widespread interest in understanding when, to what, and how to adapt – both from decision-makers and climate and social scientists. The rapid proliferation of adaptation research raised expectations that emerging knowledge in this field would inform policy at different scales and contexts (Moss *et al*. 2013). However, adaptation decision-making is complex and precarious in the sense that it is contingent on uncertain local circumstances and on downscaled climate projections that are plagued by methodological, theoretical, and technical uncertainties.

In addition, local decision-makers face a number of governance challenges to adaptation, including: (1) conflicting timescales; (2) substantive, strategic, and institutional uncertainty; (3) institutional crowdedness and institutional void; (4) institutional fragmentation; (5) lack of awareness and communication; (6) motivation and unwillingness to act; and (7) lack of resources. Uncertainty can also emerge through the quality, availability, legitimacy, and credibility of knowledge used in decision-making (Koppenjan and Klijn 2004; Zegwaard *et al*. 2015). While adaptation planning and implementation has largely been focused on the national scale, the past decade has seen emphasis on locally based adaptation initiatives, because adaptation is inherently context-specific given impacts at the local level and the ability of different systems to respond to them (Measham *et al*. 2011; Eyzaguirre and Warren 2014; Biesbroek *et al*. 2011).

We focus on three case studies where the challenges of climate adaptation are brought to the fore through the application of climate knowledge in the context of the management of different natural resources threatened by climate change. We chose these cases (from Brazil, the US, and Canada) because they illustrate the complexities of decision-making at the science–policy interface under conditions where different actors are operating under different types of uncertainty that can leave them more of less vulnerable. They also show how adaptation action exposes political risk and entrepeneurship, at times, with ambiguous and potentially negative outcomes. In analysing these stories, we deploy and use the

concept of 'precariousness', defined as an emotive dimension tied to uncertainty that can introduce a level of peril into the process of applying knowledge to decision-making.

The first case looks at water management decision-making in Brazil and involves technocrats, local stakeholders and public officials in water governance in the state of Ceará, in Northeast Brazil. It examines the dilemmas of participatory and integrated water management in the context of scarcity and the ability to predict future climate. The second case shows how local decision-makers, such as planners in the US, are developing and implementing adaptation plans in the absence of leadership and support from the state and federal governments. In the third case, the focus is on how the adaptation science–policy interface generates new forms of vulnerability in coastal communities in New Brunswick, Canada. We discuss how vulnerability assessments, which are common science–policy interfacing mechanisms in adaptation planning, not only produce actionable knowledge for decision-makers, but also bring to the fore how knowledge production can exacerbate precariousness in the form of new community vulnerabilities.

Climate adaptation science and policy interface

The increasing interaction between knowledge producers and users in the adaptation arena has brought to the fore new complexities and implications of uncertainty. For scientists responding to users' desire for more specific and deterministic knowledge, quantifying uncertainties associated with global climate change models is an attempt to meet users' needs (Hartman *et al*. 2002). In the process, scientists expect to make global environmental change research more salient, legitimate, and policy relevant. Implicit in this position is the perspective that the earth will warm enough to warrant adapting to the impact of climate change, despite the uncertainties of climate models. Hence in the eyes of the scientists producing climate information, uncertainty may appear relatively 'small' and manageable for local decision-making. For decision-makers, however, the uncertainty associated with climate models is large enough to paralyse action and warrant waiting to respond until better evidence is produced (Lemos and Rood 2010). In this perspective, scientific uncertainty is 'large', compounding the uncertainties associated with local adaptation decision-making, which include many different socio-economic and political risks. Here, not all uncertainties are made equal and understanding the implications of how they arise and how different actors deal with them is important.

Coping with uncertainty at the science–policy interface may require different strategies depending on different degrees of tolerance to the unpredictability of outcomes in adaptation decision-making and how scientists and decision-makers perceive and anticipate public perceptions of uncertainty (van der Sluijs 2005; Brugnach *et al*. 2007; Wardekker *et al*. 2008; Monteiro and Rajão 2017). Law (2004) notes that science tends to ignore the messiness of discursive practices, objects of study, and different knowledge systems, reducing the heterogeneity

or multiplicity of scientific research objects to a singular reality. This is important, not only because of how uncertainty is understood and characterized, but also because of how uncertainty is experienced by scientists and decision-makers at the science–policy interface is the basis of policy options and their implementation.

For instance, uncertainty surrounding the outputs of climate models (e.g. climate projections and forecasts) is frequently cast as one of the most challenging barriers for the use of climate information in decision-making (Lemos and Rood 2010; Lewandowsky *et al*. 2015). It is reasonable to speculate that the roots of this challenge stem both from the politics of how projections and forecasts are 'produced' and from the politics of climate change policy-making in different contexts. On the one hand, in scientific research, understanding and managing uncertainty is both a motivator and an important mechanism of research (Mearns 2010; Lemos and Rood 2010). Climate scientists often think of uncertainty as an integral part of their scholarship and decreasing it is not necessarily an end goal (Lemos and Rood 2010). On the other hand, decision-makers also grapple with large uncertainties when they make decisions about the future using a myriad of data, decision-support tools, models, and scientific knowledge (Woodruff and Stults 2016). These uncertainties are normalized into the expected and tolerated risks of doing their job either through professional training or well-established routines.

Yet, the extent to which the difference between these two camps is forged is still relatively unexplored. The uncertainty surrounding scientific knowledge can *always* be used by stakeholders to justify their positions, but in practice, knowledge and uncertainty from scientific investigation is only one element of a myriad of other sources and types of knowledge and uncertainty that inform decision-making. We distinguish between two objects of study – scientific uncertainty and decision-making uncertainty. Rather than independent and separate ideas, these two kinds of uncertainty co-create each other in specific science–policy interfaces. And in doing so, they bring to the fore a certain level of precariousness in the way knowledge is made and used.

The precariousness of uncertainties

Uncertainty is hard to define and difficult to quantify. For climate science many kinds of uncertainty exist, such as: (1) uncertainties in the prediction of parameters intrinsic to the physical climate – these uncertainties can be quantified by comparison of model projections with observations and may be directly related to details of the model construction; (2) uncertainties in our knowledge of the amount of greenhouse gases that will be emitted due to the enterprise of humans – these are decision-based and, hence, outside of the realm of physical science; (3) uncertainty regarding the fact that we know that there are processes in the climate models that are potentially important and poorly or unrepresented; and (4) uncertainty regarding the process through which projections are produced in terms of scientific credibility, transparency,

and legitimacy. These uncertainties often compound one another. We are left, therefore, with the daunting complexity of the quantification and specification of scientific uncertainty. And whereas we can assess the uncertainty well enough to know we need to reduce the emissions of greenhouse gases – that is, to motivate the development of mitigation policy – we still fall short of being able to inform policy-makers, for example, of the dimension, time, and spatial distribution of the impacts of climate change that could support adaptation planning.

Science-based uncertainty is a product of the research process that makes decision-making more complex. In response to users' perceived needs, there has been a focus on developing more powerful and scaled-down climate predictions (Mearns 2010). Although climate scientists continuously affirm their commitment to reduce uncertainty to improve the relevance of their predictions to decision-makers, in the eyes of many scientists, it is a fallacy that scientific uncertainty is the root cause of the lack of use of climate knowledge in the development of policy (Lemos and Rood 2010). Yet, we also know that, in reality, the use of forecasts and projections, and the implications of scientific knowledge and uncertainty in shaping it, is strongly influenced by who is involved in knowledge co-production and how science–policy interfaces are influenced by broader socio-technical imaginaries of the future (Jasanoff and Kim 2009; Meehan *et al*. 2017).

Scientists may express in quantifiable terms how uncertain their knowledge and models of climate change impacts are, and sometimes this uncertainty may put them in a precarious position (e.g. their reputation or employment might be at stake, or their characterization and measurement of uncertainty may render other people's livelihoods more or less precarious) (Lemos and Dilling 2007). Users in turn, may be subject to the same limitations and perceptions when pushed to act outside their envelope of experience or comfort zone (Milly *et al*. 2010). Precarious as an adjective thus describes a state of instability, insecurity, and uncertainty that could also indicate a level of exposure to risk or danger. Embedded within the concept of precariousness is an emotive dimension that is tied to uncertainty – the feelings, perceptions, and experiences of what is dangerously insecure, unstable, and/or perilous.

We argue that when uncertainty is experienced by researchers or decision-makers as precariousness, it can affect knowledge production and decision-making. It also plays a central role in explaining how scientific uncertainty becomes decision-making uncertainty at the science–policy interface and vice-versa. Hence, we operationalize the term 'precariousness' within the context of this research as an analytical term to examine the limits imposed on knowledge creation and use by factors that are beyond the control of scientists and users. As the following three cases illustrate, precariousness highlights the lived experience of uncertainty for scientists and decision-makers. At the same time, it refocuses our attention from an abstract, quantitative measure of uncertainty to how a sense of dependence on circumstances beyond one's control affects knowledge production and decision-making.

Tale 1: reform-oriented technocrats and the greater good

In the early 1990s, a sweeping decentralized water management reform in Brazil created a national level participatory system that included not only public officials but also large water users and representatives of civil society. A common assumption behind the expectation of the creation of successful river basin committees was that participation *mattered* both in terms of outcomes and processes. The overall hope was that stakeholder involvement would contribute to solving water-related problems while promoting desired practices such as democratization, transparency, and accountability in water management decision-making. Yet, empirical evidence on the ability of stakeholder partnerships to reach these goals has been mixed (Abers and Keck 2006; Ioris 2010). One particularly critical issue has been the role that climate knowledge can or has played in building the adaptive capacity of the systems to respond to climate variability and change and in mediating the democratization of decision-making (Lemos *et al*. 2010; Engle and Lemos 2010), since the emergence of these new organizations has brought to the foreground issues of representation and participation that strongly influence the equitable management and use of water resources (Taddei 2011).

Relative to water management, one reasonable hypothesis is that climate knowledge contributes to better water use by informing stakeholders about system capacity and fluctuations, potential disruptions to resource availability (e.g. drought or flooding), implications of intra- and inter-basin water transfers, and long-term availability and intergenerational implications of different levels of resource use (i.e. climate change impact scenarios). It also informs stakeholders about the implications of water quality for current use and future sustainability of water resources and supports decisions regarding water zoning plans and pricing schemes. In this sense, knowledge may in effect contribute to increased democratization in decision-making since better-informed stakeholders can make better-informed decisions. In contrast, knowledge can insulate decision-making and exacerbate power imbalances between those with access to knowledge and those without. Under the guise of expertise, technocrats can alienate stakeholders from the decision arena. In such cases, knowledge can be one factor enabling 'elite capture' of decision-making, thereby critically affecting water allocation and use, potentially leading to maladaptation. Figure 7.1 suggests a simplified heuristic for the role knowledge can play at the intersection of participation and governance in predicting adaptation outcomes (Lemos *et al.* 2020).

Empirical research, however, revealed that the practical outcomes of techno-scientific knowledge use (including climate information) in the Brazilian decentralized water management scheme resided more or less in the middle. While control and access to knowledge lent individuals with a strong technical background, locally referred to as 'technocrats', a great deal of authority in shaping decision-making, this unequal exercise of power was not necessarily perceived as negative by the majority of stakeholders involved. Indeed, many in the river basin committees perceived the role of technocrats as more neutral than other

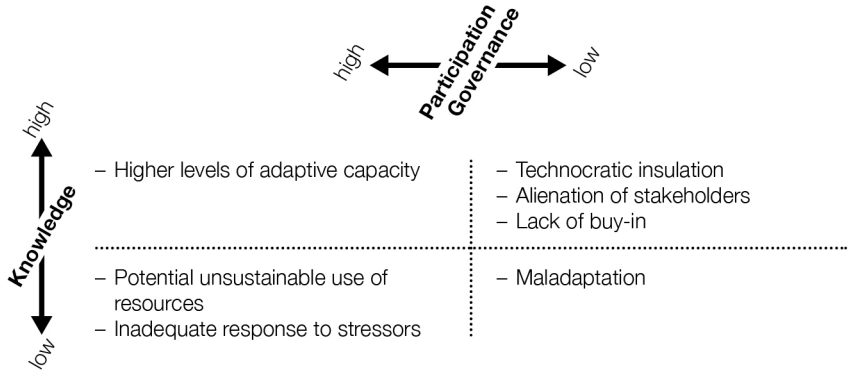

Figure 7.1 A typology of adaptability (based on Lemos *et al.* 2020).

interests and welcomed their ability to curb the influence of powerful actors in the private and public sectors (businesses, large public water users, and the electric power sector, for example) and to advocate for the interests of less powerful and visible actors and systems such as small farmers or ecosystem services (Lemos and Rood 2010).

This accepted role of technocrats is deeply seated in Brazil's policy traditions. Throughout its republican history, but especially in the 1960s and 1970s, political leadership (both democratically elected and authoritarian) attempted to insulate bureaucratic systems as a strategy to foment development. By singling out some agencies and providing them with financial and human resources unavailable to the bulk of the 'common' bureaucracy, these leaders expected insulated technocracies to perform at a higher level of competency than other sectors of the government. Insulated agencies attracted high-quality professionals by offering market competitive wages and fringe benefits, by adopting strict meritocratic selection and promotion processes, and by 'protecting' their decision-making from traditional political meddling. The technocracy differed from traditional bureaucracy to the extent that its performance depended on specific technical and professional expertise. Most importantly, they operated from decentralized agencies (public and mixed enterprises and autonomous entities) that were relatively protected from practices such as clientelism, nepotism, rent-seeking, and corruption (Nunes and Geddes 1987). In effect, this governance arrangement mitigated the precariousness of technocrats' work – limiting the social, political, and economic uncertainties that most decision-makers must address when making decisions. As a result, insulated technocracies operate virtually unchallenged and in this context the values and belief systems of technocrats and how they use scientific knowledge and expertise to push different agendas become the best predictor of 'good' and 'bad' decisions. This is particularly complex in the context of decisions based on information with high levels of uncertainty as

projections can create almost a 'blank canvas' on which technocrats can exert great freedom in shaping their desired outcomes.

One particularly critical example of the role of climate information and uncertainty in shaping governance and participation is that of reservoir management in the state of Ceará in Northeast Brazil. In 2001, after a number of low rainfall years a severe drought event substantially depleted water resources in one of the largest reservoirs in the state (Jaguaribe/Banabuiu) (Formiga-Johnsson and Kemper 2005). The reservoirs reached critically low levels, making it impossible to guarantee water for all users. As a result, there were severe conflicts over water that could not be resolved by negotiated allocation. The water reform required the prioritization of water for human consumption, especially in the state's capital city, Fortaleza, thus requiring some agricultural producers to go without water. In the yearly allocation meetings with the river basin committee, technocrats from the state water management agency presented a series of reservoir models with different levels of projected charge and discharge options (supposedly based on yearly rainfall projections) to impart on users the need to reduce irrigation by 50 per cent to avoid jeopardizing perennial crops.

Although in principle these scenarios reflected 'real' water availability, in reality, they were built very conservatively, with a high security margin and an assumption of zero rainfall, irrespective of the forecast for the incoming wet season. While the allocation was indeed negotiated, managers tightly controlled information, seeking to conserve water in the system. In this instance, technocrats were able to foster a higher level of risk-averseness (their own) into the river basin committee decision-making by carefully circumscribing the scientific uncertainty associated with water use. The fact that it worked (the reservoir did not 'dry', a common occurrence on similar droughts in the region) only reinforced their belief that water users needed to be carefully controlled to guarantee the least possible consumption of water, which in their minds was for 'a greater good'.

This story highlights how scientific uncertainty associated with rainfall and reservoir models is co-created with uncertainties associated with decision-making. Precariousness is at the core of this complex situation and helps explain how scientific uncertainty was mobilized to reduce access to water for some users, while protecting other users' access to water. Technocrats utilized the appearance of scientific uncertainty (by producing excessively conservative models and assuming zero rainfall) to convince stakeholders that water allocation required reprioritization. The decision-making context was precarious in the sense that technocrats had to weigh different needs, interests, and impacts to allocate water rights. On the one hand, scientific uncertainty was marshaled to reduce some uncertainties – the population of Fortaleza's access to water and maintaining reservoir levels. On the other hand, farmers were made even more dependent on circumstances beyond their control, exposing their livelihoods to greater uncertainty. While technocrats' own precariousness was limited due to their social and political positions, their decisions directly affected different user groups' exposure to drought.

Tale 2: adaptation by stealth in the heartland

In contrast to Brazil, watershed management and climate change adaptation in the US is much less regulated and institutionalized at the federal level. Local and regional governance systems are thought to be more effective at addressing scientific and decision-making uncertainties and challenges (Sanchez-Rodriguez 2009; Mukheiber *et al*. 2013; Hanssen *et al*. 2013; Termeer *et al*. 2011; Dannevig and Aall 2015; Jacobs *et al*. 2016; Antonson *et al*. 2016) but the lack of support of higher scales can severely limit action (Rassmussen *et al*. 2017). In a multi-level governance perspective, local institutions play a crucial role in local knowledge mobilization, setting priorities for action, building adaptive capacity, strengthening social capital within the community and in international networks of climate change governance, and in the implementation of climate change policies (Bulkeley and Betsill 2005; Cashmore and Wejs 2014; Urwin and Jordan 2008). However, climate change planning and action represent an added financial burden to municipal governments already short on resources to provide the services under their jurisdictions (Crabbé and Robin 2006). In polycentric governance, they can also mask power differentials and disconnects between knowledge and action (Morrison *et al*. 2017; Lemos 2015).

Such fiscal challenges, and the recognition that climate change impacts spill-over local political boundaries, have led to calls for regional governance arrangements (Termeer *et al*. 2011; Antonson *et al*. 2016; Dannevig and Aall 2015). Empirical studies have highlighted the capacity of regional and metropolitan arrangements to support local level adaptation, encourage the emergence of climate entrepreneurs, and foster integrated land-use planning that mitigates climate risks (Hanssen *et al*. 2013; Jacobs *et al*. 2016; Dannevig and Aaall 2015; Kalafatis and Lemos 2017). However the relationship between local level decision-making and regional governance institutions have been found to be fraught with tensions often associated with different uncertainties such as the non-linearity of projected climate change impacts and lack of political support (Folke *et al*. 2005; Rockstrom *et al*. 2009). These complexity and scale dependencies represent a strong hurdle to climate uptake and use in practice.

In the Great Lakes region, for example, a variety of schemes are in place at the state, trans-state, and county levels often in some form of hybrid governance, including: state, county, private (NGOs, watershed organizations), and community/city-based organizations. In this context, the use (or lack thereof) of climate change information has varied considerably from watershed to watershed. For example, empirical research comparing two watersheds (Maumee, OH and Huron, MI) find markedly different approaches. Whereas managers in the Huron watershed have been much more forthcoming and willing to consider climate information in its management, resistance among managers to use climate information in the more conservative Maumee watershed has been much higher (Rasmussen *et al*. 2017).

One possible explanation is the role of boundary organizations that facilitate in-depth discussions between climate scientists and water managers, including around uncertainty and the scale of decision that fits available regional climatologies and projections (Briley *et al*. 2015). In contrast, in the Maumee, the issue of climate change is much more coloured by regional/local politics and acceptance of climate change as a public policy problem. In the absence of a clear mandate from higher governance scales (state, federal), there is a double-loop negative feedback in which public officials on higher echelons claim there is no demand for climate action or information from lower scales, while city and community managers claim that lack of a mandate ties their hands towards planned adaptation (Rasmussen *et al*. 2017). In this context, a few urban water systems adapt 'by stealth', that is, by mainstreaming climate-related adaptation into more politically palatable action in the context of sustainable development (Rasmussen *et al*. 2017).

Similarly, scholarship focusing on implementation of adaptation plans in the US finds that although the number of plans is steadily increasing, actual implementation is lacking (Woodruff and Stults 2016). Managing uncertainty related to model projections is often a theme of these plans, despite urban planners' historical dealings with high levels of uncertainty ('plan uncertainty') in their day-to-day jobs. For example, in analysing over 40 adaptation plans in the US, Woodruff and Stults (2016) found that planners apply a number of uncertainty mitigation strategies, including vulnerability assessments and climate policy mainstreaming. However, their work also finds that planners appear to be more willing to manage/mitigate climate uncertainty and other kinds of related uncertainty under their control.

Adapting 'by stealth' illustrates the precariousness of planners' work in a context of political and economic uncertainty. Here, planners try to plan for climate impacts, incorporating scientific uncertainty within their plans, despite working in agencies that perpetuate the notion that there is insufficient knowledge to adapt. Planners are in effect 'making' adaptation policy by producing adaptation plans, yet their efforts are dependent on the will of politicians to implement these plans. Without financial, institutional, and political support, plans remain plans. When planners take it upon themselves to implement plans and help coordinate efforts by other actors in adaptation governance, they expose themselves to political liabilities. Yet, as front-line workers, planners are faced in their day-to-day work with the impacts of climate change on communities – they have learned to manage scientific uncertainty in order to respond to urgent needs within their communities.

Tale 3: the trouble with vulnerability assessments

In 2013, the non-governmental organizations, the St. Croix Estuary Project Inc. and Eastern Charlotte Waterways Inc., organized the Charlotte County Community Vulnerability Assessment (CCCVA). The CCCVA process was led by civil society groups but also included experts trained in producing

maps of inland flooding risks and future sea-level rise scenarios, municipal decision-makers and regional agencies involved in emergency response planning (Signer *et al*. 2014). The CCCVA was funded in part by the provincial government in an effort to mainstream climate change adaptation across the different levels of decision-making within New Brunswick. Organized around working groups from five coastal municipalities, the CCCVA met bi-weekly to enable Charlotte County communities to share knowledge and concerns relative to climate change, as well as to develop and share information on such topics as socio-economic systems, sea-level rise, and inland flooding (Signer *et al*. 2014).

The CCCVA was a science–policy interfacing mechanism that sought to produce knowledge and steer adaptation decision-making towards the most pressing impacts of climate change in Charlotte County. This county is situated in the southwestern region of the Atlantic province of New Brunswick, Canada. In the last five years, severe weather events have battered the region with strong winds, extreme high tides, and major rainstorms. In December 2013, a series of intense storm events with freezing rain, ice pellets, extreme wind chill temperatures, and snow storms hit the region for an extended period. Since then, the region has been hit by tropical hurricane Arthur and others. Together, these events have affected health and household savings, damaged infrastructure, disrupted services and the economy, and caused environmental damage (Signer *et al*. 2014). Similar events across the province have led the government of New Brunswick to prioritize flood risk prevention in its climate change adaptation strategy (Province of New Brunswick 2014).

The CCCVA process helped reveal which community elements are most vulnerable to environmental and climatic changes and informed the development of efforts to build community resilience (Signer *et al*. 2014). A number of tools were used to co-produce knowledge with academics, community members, and decision-makers, including flooding scenarios (using LiDAR data and IPCC scenarios to create scenarios of future sea-level rises in the region), wet-areas mapping (using provincial digital elevation data), and participatory vulnerability mapping, which consisted of community-designated locations within communities corresponding to social, environmental, and economic vulnerabilities. The CCCVA also included participant interviews to gain a better understanding of how this knowledge production process affected working group members and their communities, and their expectations of the CCCVA process (Klenk *et al*. 2017a, 2017b; Klenk 2018).

The CCCVA produced a number of useful maps and outputs that were subsequenty utilized by the five communities to raise awareness about climate impacts and begin adaptation planning (Kim Reeder, personal communication November 2017). Yet, during the CCCVA process, concerns emerged about how the vulnerability assessment might affect property values. The CCCVA maps identifed at-risk buildings which raised concerns about whether and how this information ought to be communicated to local citizens, and what responsibilities local decision-makers and CCCVA participants had toward stakeholders

who were not part of the knowledge-production process, but whose homes or businesses were expected to be under water in 50 years time. It is important to note that these coastal communities are situated in a rural, economically depressed region of the province and increasingly characterized by an aging demographic with low and/or fixed incomes (Finn 2008; Signer *et al*. 2014). The inability to sell a property because climate change projections suggest sea level rise will destroy the property in less than two generations unless aggressive adaptation action is taken represents not only a new economic vulnerability for individual property owners, but a vulnerability for municipalities who may be liable for producing this knowledge and/or implementing zoning or relocalization policies based on these vulnerability maps. In response, the organizers followed up with presentations of the results to the community and legal studies focused on the town's liability (Kim Reeder, personal communication November 2017).

This example illustrates the unintended effects of research about adaptation: the potential for science–policy interfacing to exacerbate decision-making uncertainties and the precariousness of living in coastal communities in the face of sea level rise and extreme weather events. In this case, the uncertainty of climate model projections, sea level rise, and flood area maps is trumped by the uncertainties created by the vulnerability assessment itself. Local and regional decision-making uncertainty was compounded by this new uncertainty and the scientists and organizers of the CCCVA had to take responsibility for producing this risky knowledge (Klenk 2018). Knowledge-making practices can create new uncertainties and experiences of precariousness to which not only individual and local communities must adapt, but also researchers and decision-makers working at the science–policy interface.

Conclusion

The encounter between the lived experience of scientific and decision-making uncertainties in our three cases illustrate how these uncertainties differ but also co-create each other. Climate science uncertainties persist and new ones are sometimes created despite our best modelling efforts, theoretical sophistication, and participatory knowledge production processes. Adaptation decision-making is likewise fraught with uncertainties and as our first two cases suggest, scientific uncertainties may simplify the decision-making process or make it more complex. In all three cases, how uncertainties affect decision-making is linked to the precariousness they are associated with.

In this chapter, we argue that how scientists and decision-makers perceive and mitigate against the precariousness of knowledge, life, and livelihoods gets expressed in the language of uncertainty, with its quantifiable variables and management techniques. Yet uncertainty estimates and statistics seldom move people to action. However, when viewed from the perspective of precariousness, uncertainty becomes affective. Using this language may serve to gain a better understanding of how uncertainty is lived and managed in both science and decision-making.

References

Abers, R. N. and Keck, M. E. (2006) 'Muddy Waters: The Political Construction of Deliberative River Basin Governance in Brazil', *International Journal of Urban and Regional Research* 30(3): 601–22.

Adger, W. N. and Vincent, K. (2005) 'Uncertainty in Adaptive Capacity', *Comptes Rendus Geoscience* 337(4): 399–410.

Antonson, H., Isaksson, K., Storbjörk S. and Hjerpe, M. (2016) 'Negotiating Climate Change Responses: Regional and Local Perspectives on Transport and Coastal Zone Planning in South Sweden', *Land Use Policy* 52: 297–305.

Biesbroek, R., Klostermann, J., Termeer, C. and Kabat, P. (2011) 'Barriers to Climate Change Adaptation in the Netherlands', *Climate Law* 2(2): 181–99.

Briley, L., Brown, D. and Kalafatis, S. E. (2015) 'Overcoming Barriers during the Co-Production of Climate Information for Decision-Making', *Climate Risk Management* 9: 41–9.

Brugnach, M., Tagg, A., Keil, F. and de Lange, W. J. (2007) 'Uncertainty Matters: Computer Models at the Science–Policy Interface', *Water Resource Mangement* 21(7): 1075–90.

Bulkeley, H. and Betsill, M. (2005) 'Rethinking Sustainable Cities: Multilevel Governance and the "Urban" Politics of Climate Change', *Environmental Politics* 14(1): 42–63.

Cashmore, M. and Wejs, A. (2014) 'Constructing Legitimacy for Climate Change Planning: A Study of Local Government in Denmark', *Global Environmental Change* 24: 203–12.

Crabbé, P. and Robin, M. (2006) 'Institutional Adaptation of Water Resource Infrastructures to Climate Change in Eastern Ontario', *Climatic Change* 78(1): 103–33.

Dannevig, H. and Aall, C. (2015) 'The Regional Level as Boundary Organization? An Analysis of Climate Change Adaptation Governance in Norway', *Environmental Science and Policy* 54: 168–75.

Engle, N. L. (2011) 'Adaptive Capacity and Its Assessment', *Global Environmental Change–Human and Policy Dimensions* 21(2): 647–56.

Engle, N. L. and Lemos, M. C. (2010) 'Unpacking Governance: Building Adaptive Capacity to Climate Change of River Basins in Brazil', *Global Environmental Change-Human and Policy Dimensions* 20(1): 4–13.

Eyzaguirre, J. and Warren, F. J. (2014) 'Adaptation: Linking Research and Practice', in F. J. Warren and D. S. Lemmen (eds) *Canada in a Changing Climate: Sector Perspectives on Impacts and Adaptation*, Ottawa, ON: Government of Canada, 253–86.

Finn, J.-G. (2008) *Building Stronger Local Governments and Regions: An Action Plan for the Future of Local Governance in New Brunswick: Report of the Commissioner on the Future of Local Governance*, New Burnswick, CA: Government of New Burnswick.

Folke, C., Hahn, T., Olsson, P. and Norberg, J. (2005) 'Adaptive Governance of Social-Ecological Systems', *Annual Review of Environment and Resources* 30: 441–73.

Formiga-Johnsson, R. M. and Kemper, K. E. (2005) 'Institutional and Policy Analysis of River Basin Management in the Jaguaribe River Basin, Ceará, Brazil', *Policy Research Working Paper 3649*, Washington, DC: World Bank.

Hanssen, G. S., Mydske, P. K. and Dahle, E. (2013) 'Multi-Level Coordination of Climate Change Adaptation: By National Hierarchical Steering or by Regional Network Governance?', *Local Environment* 18(8): 869–87.

Hartmann, H. C., Pagano, T. C., Sorooshian, S. and Bales, R. (2002) 'Confidence Builders: Evaluating Seasonal Climate Forecasts from User Perspectives', *Bulletin of the American Meteorological Society* 83(5): 683–98.

Ioris, A. A. (2010) 'The Political Nexus between Water and Economics in Brazil: A Critique of Recent Policy Reforms', *Review of Radical Political Economics* 42(2): 231–50.

IPCC (Intergovernmental Panel on Climate Change) (2014) *Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*, Geneva.

Jacobs, B., Lee, C., Watson, S., Dunford, S. and Coutts-Smith, A. (2016) 'Adaptation Planning Process and Government Adaptation Architecture Support Regional Action on Climate Change in New South Wales, Australia', in L. Filho (eds) *Innovation in Climate Change Adaptation*, Cham: Springer, 17–29.

Jasanoff, S. and Kim, S. H. (2009) *Dreamscapes of Modernity: Sociotechnical Imaginaries and the Fabrication of Power*, Chicago, IL: University of Chicago Press.

Kalafatis, S. E. and Lemos, M. C. (2017) 'The Emergence of Climate Change Policy Entrepreneurs in Urban Regions', *Regional Environmental Change* 17(6): 1791–9.

Kirchhoff, C. J., Lemos, M. C. and Engle, N. L. (2013) 'What Influences Climate Information Use in Water Management? The Role of Boundary Organizations and Governance Regimes in Brazil and the US', *Environmental Science and Policy* 26: 6–18.

Klenk, N. (2018) 'Adaptation Lived as a Story: Why We Should Be Careful about the Stories We Use to Tell Other Stories', *Nature and Culture* 13(3): 322–55.

Klenk, N., Flueraru, D. and MacLellan, J. I. (2017) 'Experimentalist Regional Governance for Climate Change Adaptation: A Canadian Case Study', in W. L. Filho and J. M. Keenan (eds) *Climate Change Adaptation in North America: Experiences, Case Studies and Best Practice*, Berlin: Springer, 51–66.

Klenk, N., MacLellan, J. I., Flueraru, D. and Reeder, K. (2017) 'Climate Hazards, Local Knowledge Co-Production, and the Emergence of Climate Adaptation Publics: Governance Implications', in W. L. Filho (eds) *Climate Change Impacts and Adaptation Strategies in Costal Communities*, Berlin: Springer, 261–81.

Koppenjan, J. F. and Klijn, E.-H. (2004) *Managing Uncertainties in Networks: A Network Approach to Problem Solving and Decision Making*, London: Routledge.

Kuklicke, C. and Demeritt, D. (2016) 'Adaptive and Risk-Based Approaches to Climate Change and the Management of Uncertainty and Institutional Risk: The Case of Future Flooding in England', *Global Environmental Change* 37: 56–68.

Law, J. (2004) *After Method: Mess in Social Science Research*. International Library of Sociology, London: Routledge.

Lemos, M. C. (2015) 'Usable Climate Knowledge for Adaptive and Co-Managed Water Governance', *Current Opinion in Environmental Sustainability 12*: 48–52.

Lemos, M. C. and Dilling, L. (2007) 'Equity in Forecasting Climate: Can Science Save the World's Poor?', *Science and Public Policy* 34(3): 109–16.

Lemos, M. C. and Rood, R. (2010) 'Climate Projections and Their Impact on Policy and Practice', *Wiley Interdisciplinary Reviews: Climate Change* 1(5): 670–82.

Lemos, M. C., Bell, A., Engle, N. E., Formiga-Johnsson, R. M. and Nelson, D. R. (2010) 'Technical Knowledge and Water Resources Management: A Comparative Study of River Basin Councils, Brazil', *Water Resource Research* 46(6): 1–12.

Lemos, M. C., Kirchhoff, C. and Ramparasad, V. (2012) 'Narrowing the Climate Information Usability Gap', *Nature Climate Change* 2(11): 789–94.

Lemos, M. C., Puga, B. P., Formiga-Johnsson, R. M. and Seigerman, C. K. (2020) 'Building on Adaptive Capacity to Extreme Events in Brazil: Water Reform, Participation, and Climate Information Across Four River Basins', *Regional Environmental Change* 20(53). DOI https://doi.org/10.1007/s10113-020-01636-3

Lewandowsky, S., Oreskes, N., Risbey, J. S., Newell, B. R. and Smithson, M. (2015) 'Climate Change Denial and Its Effect on the Scientific Community', *Global Environmental Change* 33: 1–13.

Mearns, L. O. (2010) 'The Drama of Uncertainty', *Climatic Change* 100(1): 77–85.

Measham, T. G., Preston, B. L., Smith, T. F., Brooke, C., Gorddard, R., Withycombe, G. and Morrison, C. (2011) 'Adapting to Climate Change through Local Municipal Planning: Barriers and Challenges', *Mitigation and Adaptation Strategies for Global Change* 16(8): 889–909.

Meehan, K., Klenk, N. and Méndez, F. (2017) 'The Geopolitics of Climate Knowledge Mobilization: Transdisciplinary Research at the Science–Policy Interface(s) in the Americas', *Science, Technology and Human Values*: 43(5): 759–84.

Milly, P., Julio, B., Malin, F., Robert, M., Zbigniew, W., Dennis, P. and Ronald, J. (2008) 'Stationarity Is Dead', *Science, American Association for the Advancement of Science* 319 (5863): 573–4.

Monteiro, M. and Rajão, R. (2017) 'Scientists as Citizens and Knowers in the Detection of Deforestation in the Amazon', *Science, Technology and Human Values* 47(4): 466–84.

Morrison, T. H., Adger, W. N., Brown, K., Lemos, M. C., Huitema, D. and Hughes, T. P. (2017) 'Mitigation and Adaptation in Polycentric Systems: Sources of Power in the Pursuit of Collective Goals', *Wiley Interdisciplinary Reviews: Climate Change* 8(5): e479.

Moss, R. H., Meehl, G. A., Lemos, M. C., Smith, J. B., Arnold, J. R., Arnott, J. C., Behar, D., Brasseur, G. P., Broomell, S. B., Busalacchi, A. J., Dessai, S., Ebi, K. L., Edmonds, J. A., Furlow, J., Goddard, L., Hartmann, H. C., Hurrell, J. W., Katzenberger, J. W., Liverman, D. M., Mote, P. W., Moser, S. C., Kumar, A., Pulwarty, R. S., Seyller, E. A., Turner, B. L., Washington, W. M. and Wilbanks, T. J. (2013) 'Hell and High Water: Practice-Relevant Adaptation Science', *Science* 342: 696–8.

Mukheiber, P., Kuruppu, N. and Gero, A. (2013) 'Overcoming Cross-Scale Challenges to Climate Change Adaptation for Local Government: A Focus on Australia', *Climatic Change* 121(2): 271–83.

National Research Council (2007) *Evaluating Progress of the US Climate Change Science Program: Methods and Preliminary Results*, Washington, DC: National Research Council of the National Academies.

Nunes, E. D. O. and Geddes, B. (1987) 'Dilemmas of State-Led Modernization in Brazil', in J. D. Wirth, E. D. O. Nunes and T. E. Bogenschild (eds) *State and Society in Brazil: Continuity and Change*, Boulder, CO: Westview Press, 103–45.

Porter, J. J., Demeritt, D. and Dessai, S. (2015) 'The Right Stuff? Informing Adaptation to Climate Change in British Local Government', *Global Environmental Change* 35: 411–22.

Province of New Brunswick (2014) *New Brunswick's Flood Risk Reduction Strategy*, New Burnswick, CA: Government of New Burnswick.

Rasmussen, L. V., Kirchhoff, C. J. and Lemos, M. C. (2017) 'Adaptation by Stealth: Climate Information Use in the Great Lakes Region across Scales', *Climatic Change* 140(3–4): 451–65.

Rockstrom, J., Steffen, W., Noone, K., Persson, A., Chapin, F. S., Lambin, E. F., Lenton, T. M., Scheffer, M., Folke, C., Schellnhuber, H. J., Nykvist, B., de Wit, C. A., Hughes, T., van der Leeuw, S., Rodhe, H., Sorlin, S., Snyder, P. K., Costanza, R., Svedin, U., Falkenmark, M., Karlberg, L., Corell, R. W., Fabry, V. J., Hansen, J., Walker, B., Liverman, D., Richardson, K., Crutzen, P. and Foley, J. A. (2009) 'A Safe Operating Space for Humanity', *Nature* 461(7263): 472–5.

Sanchez-Rodriguez, R. (2009) 'Learning to Adapt to Climate Change in Urban Areas: A Review of Recent Contributions', *Current Opinion in Environmental Sustainability* 1(2): 201–6.

Signer, K., Reeder, K. and Killorn, D. (2014) *Community Vulnerability Assessment of Climate Change and Variability Impacts in Charlotte County, New Brunswick*, Blacks Harbour, NB: Eastern Charlotte Waterways.

Taddei, R. (2011) 'Watered-Down Democratization: Modernization versus Social Participation in Water Management in Northeast Brazil', *Agriculture and Human Values* 28(1): 109–121.

Termeer, C., Dewulf, A., van Rijswick, H., van Buuren, A., Huitema, D., Meijerink, S., Rayner, T. and Wiering, M. (2011) 'The Regional Governance of Climate Adaptation: A Framework for Developing Legitimate, Effective, and Resilient Governance Arrangements', *Climate Law* 2(2): 159–79.

Urwin, K. and A. Jordan (2008) 'Does Public Policy Support or Undermine Climate Change Adaptation? Exploring Policy Interplay across Different Scales of Governance', *Global Environmental Change* 18(1): 180–91.

van der Sluijs, J. (2005) 'Uncertainty as a Monster in the Science–Policy Interface: Four Coping Strategies', *Water Science and Technology* 52(6): 87–92.

Wardekker, J. A., van der Sluijs, J. P., Janssen, P. H. M., Kloprogge, P. and Petersen, A. C. (2008) 'Uncertainty Communication in Enviornmental Assessments: Views from the Dutch Science–Policy Interface', *Environmental Science and Policy* 11(7): 627–41.

Woodruff, S. C. and Stults, M. (2016) 'Numerous Strategies but Limited Implementation Guidance in US Local Adaptation Plans', *Nature Climate Change* 6(8): 796–802.

Zegwaard, A., Petersen, A. C. and Wester, P. (2015) 'Climate Change and Ontological Politics in the Dutch Delta', *Climatic Change* 132(3): 433–44.

8 The anticipative medicalization of life

Governing future risk and uncertainty in (global) health[1]

Ursula Jasper

The unforeseeability of potentially fatal risks and threats to our health are a fundamental characteristic of the human condition. Because of the fragility and finitude of life, our future bodily integrity seems particularly precious. The desire to foreknow and control the coming is therefore perhaps never as existential and immediate as when it comes to questions of health and illness. Drawing on recent works on risk and uncertainty in biomedical anthropology, this chapter seeks to demonstrate how at the beginning of the twenty-first century the future has become an ever more important reference point in the world of health. While individual and global public health differ in the exact methods they apply to control future illnesses, in both realms we witness today a trend towards the 'anticipative medicalization' of life, to borrow Foucault's term: the creation of an 'increasingly dense and important network' of big data-driven diagnostic and surveillance technologies that allows fewer and fewer potential risks to our well-being – diseases, pathogens, defective genes – to escape (Foucault 2003: 273).

In the first section of this chapter, I will use the example of (pre- or post-natal) genetic testing and diagnosis to exemplify how individual health is more than ever shaped by attempts to predict and prevent the onset of illnesses. While this opens up new avenues for preventive healthcare, the societal implications cannot yet be fully estimated. Arguably, the 'predictive euphoria' of certainty and controllability could also be leading towards a risk avoidance imperative in the future. Individuals might be pressured to be aware of, control and manage their genetic inheritance far-sightedly and to make the 'right' (reproductive and lifestyle) decisions in light of potential genetic risks. In more general terms, this can be interpreted as a move from primarily curative and remedial measures towards prediction, manageability and prevention.

A similar anticipative turn is observable on the global level, even though the applied technologies are different. In the second (and central) section of this chapter I will show how today's global efforts at communicable disease mitigation likewise mirror attempts to foresee future public health threats through the collection and analysis of large amounts of health-related data. However, since the prediction of outbreaks and pathways of communicable disease risks is still in an early stage, global health policy needs to employ different tools: A recently established, dense net of all-risk surveillance structures for the real-time detection

of (newly) emerging disease events is supplemented by measures to achieve preparedness and resilience.

Despite the different methods at play on the individual and the global levels, there appears to be a larger, unifying pattern: I argue that we can observe a growing desire to anticipate and reign over our future health by expanding the range, functionality and applicability of biotechnological tools and practices of prediction and surveillance based on big data, digitalization and artificial intelligence.

Predictive genetic diagnostics, actual risk assessments and the individualization of responsibility

In May 2013, Hollywood actress Angelina Jolie publicly disclosed in a *New York Times* article that she had undergone prophylactic breast cancer surgery after finding out that she carried a mutation of the so-called 'breast cancer gene' BRCA1 – a rare genetic condition that significantly increases the risk for developing certain cancer types among women (Jolie 2013; Kamenova *et al*. 2014). While her public revelation and the ensuing media coverage were certainly unusual and in large part due to her particular status as a global celebrity, her choice is emblematic for a larger trend in (Western, industrialized states') human medicine. Since the start of the Human Genome Project in 1990, scientists have been making ground-breaking advances in the field of human genetics. These developments have made it possible not only to sequence and catalogue the 3 billion human DNA base pairs, but also to search for gene–disease associations, i.e. for gene mutations that might cause illnesses even at later stages of one's life. Facilitated by the fast growth of digital healthcare, artificial intelligence and machine learning, genetic epidemiology and molecular diagnostics and, subsequently, the preventive treatment of potential medical conditions have become major and fast growing pillars of modern medicine. The National Center for Biotechnology Information, for example, now lists more than 10,000 medical conditions for which genetic tests are available (NCBI 2018).

Although critics caution against flawed and over-deterministic interpretations of today's diagnostic results (Katsanis and Katsanis 2013: 423) and point at the many unsolved questions surrounding the security and ownership of personal health data, the novel tools of genetic testing and engineering have heralded the dawn of a new societal perception of individuals' susceptibility to health risks and of people's risks of falling ill, be it at birth or in adult life. Individuals are thus no longer allocated to specific risk groups according to epidemiological criteria such as blood pressure, exposure to environmental pollution or the like. Rather, a person's individual genetic code is deciphered, presumably allowing for the calculation of assertedly precise personal risk-levels. The impact of this new industry of (pre- and post-natal) predictive techniques is not limited to immediate questions of intervention and therapy. It ultimately opens up avenues for genetic engineering, enhancement and selection. Many philosophers and medical ethicists have long warned that this

'purificationist imperative' (Elshtain 2005: 170) might not only lead to an individualization of health risks, but also pave the way to genetic discrimination and stigmatization, if not human enhancement or eugenic selection of offspring (Habermas 2002; Sandel 2007).

This 'predictive euphoria' of certainty and controllability engenders expectations regarding individuals' 'appropriate' behaviour and their 'right' reactions towards these risks (Feuerstein and Kollek 2001). Because tests of genetic susceptibility and the identification of genetic 'deficiencies' are now widely available in many middle- and high-income countries, individuals become impelled to preventively find out their genetic health risks and manage their bodies and reproductive choices accordingly (Akabayashi 2014; Rose 2001: 19). The 'good genetic citizen' is obliged to control and govern his or her genetic set-up carefully and far-sightedly, to make the right (reproductive) decisions in light of predicted risks and to change his or her behaviour accordingly (Braun 2007: 12). However, if not regulated properly, 'the results of a genetic test might make some people practically uninsurable. The ensuing financial and human burden for those individuals might be equitable from a commercial standard but is still unacceptable from a societal perspective' (Nill *et al*. 2017: 3).

Despite these concerns, there seems to be a widely shared belief and trust in the benefits of genetic predictive techniques and genetic (self-)management. Arguably, Angelina Jolie's decision is thus not merely an individual-personal decision, but reflective of a broader, societally anchored socio-technical imaginary of preventive health managerialism or, as I call it, 'anticipative medicalization':[2] It is emblematic of an incremental expansion of medical practices and techniques in order to govern future health threats (Clarke *et al*. 2003; Conrad 2008; for a critical review of 'medicalization', see Davis 2006; Foucault 2003; Nye 2003).[3]

The trend towards the actuarial assessment and prediction of risks and towards individual, preventive risk-reduction and controllability of future life trajectories on a personal medical level is paralleled by a similar rise of 'anticipative medicalization' on the global level. As I will illustrate in the next section, we can observe that in recent decades the discourse in global health has shifted from a notion of defence against concrete, known illnesses towards a fear of uncertainty and uncontrollability of pathogens. This gave rise to a substantial reform, expansion and deepening of global health governance and big data-driven biomedical surveillance. This assemblage is complemented by efforts in preparedness and resilience (or what Collier and Lakoff (2015) call 'vital systems security'), since the emergence and spread of new diseases still remain unpredictable to a significant degree.

Global health governance in perspective: fighting communicable diseases

International efforts against the spread of diseases are not a new phenomenon. Early measures can be traced back to the quarantine regulations established to protect Venice and other seaport cities from plague in the fourteenth century.

Due to, at the time, insufficient insights into infectiology and disease causation, these regulations were grounded in a rather vague knowledge of pathogenic dangers. This changed, when in the early nineteenth century governments began to systematically collect statistical data on their populations (including dates of birth and death, cause of death, marriage status, profession, place of residence etc.), thereby laying the foundation of modern epidemiology (Hacking 1990). The gathered data allowed for a better understanding not only of risk factors, but also facilitated the retrospective observation of regularities and patterns such as the burden of diseases, incidence rates and mortality levels across a population and its sub-populations or in particular geographic areas. The International Sanitary Convention of 1851 reflects this rise of modern epidemiology and medical sciences and marks the first coordinated multilateral effort in evidence-based disease control (Davies *et al*. 2015).

It was only through the establishment of the World Health Organization (WHO) in 1948, though, that a more harmonized and comprehensive set of regulations replaced the hitherto patchy and weak provisions. Two principles became central for the organization's work against communicable diseases: (1) States have a duty to inform each other about the occurrence and outbreak of specific diseases on their territory; and (2) they are obliged to limit disease-countermeasures (border controls, quarantine, import bans etc.) to levels that do not unduly harm international trade and travel (Fidler 2005: 328). For most of the twentieth century, however, the regime actually only dealt with the threat posed by a very small number of known contagious diseases. The proactive control of illnesses was restricted to the fight against cholera, plague, yellow fever, smallpox, typhus and relapsing fever (World Health Assembly 1951: Art. 1; see also Fidler 2005). However, WHO had to rely on reports by governments and had no enforcement capability in case of non-reporting or undue protective measures. As a result, delayed and asynchronous or even non-reporting was widespread, since states were afraid of the reputational or economic drawbacks of transparency (Davies *et al*. 2015: 5). Moreover, any infectious disease or pathogen that was *not* part of the WHO list would not be governed by the classical WHO regime and states had no obligation to report such outbreaks.

Public health progress towards the eradication of certain syndromes (e.g. smallpox) and more general advancements in medicine in the global North in the 1960s and early 1970s further contributed to a diminished importance of WHO's efforts at countering infectious diseases. With regard to influenza, for example, MacInnes *et al*. (2014: 49) write:

> The demonstrated efficacy of influenza vaccines encouraged the notion that governments could effectively manage the disease by themselves, a perception actively encouraged and promoted by the WHO […]. The arrival of antiviral medications in the 1960s added to the pharmacological arsenal and further embedded the belief that government-led initiatives could manage the public health problem of influenza without the need for strong international intervention.

In this phase of 'epidemiologic transition' (Tulchinsky and Varavikova 2009: 44) many of the 'classical' infectious disease were disappearing or at least becoming manageable through the means available in the industrialized world.

As a consequence, and after several adjustments, WHO's list of threatening diseases was further condensed: By 1995, it encompassed only three reportable conditions (cholera, plague and yellow fever) that were deemed to pose a risk to global public health. Going beyond a mere technical or regulative alteration, this change represented a conceptual shift in experts' perception of the future of global health: The need to collectively manage imminent disease threats was overridden by a newly arising belief in the curative medical and technological capabilities of industrialized states' healthcare capacities. The perceived necessity to prepare against communicable diseases had largely given way to a 'spirit of optimism' (Mayer 2000: 938; see also Caduff 2014: 111) and an enthusiastic faith in the controllability, treatability and curability of illnesses.

The end of optimism and the 'emergence' of emerging diseases

The optimism did not last long. It was not least the spread of HIV/AIDS and the appearance or identification of other previously unknown (or disregarded) pathogens in the 1980s that suddenly put infectious diseases back on the radar screen and radically shifted key actors' approach towards governing health insecurity (King 2004). Noticeably, the dynamic was not primarily driven by WHO as the designated international authority in the realm of global health, but predominantly by the US Institute of Medicine (IoM), the US Center for Disease Control (CDC), and a small number of key virologists and microbiologists, who assumed the prerogative to foresee the future. Acting as 'agenda-setters' and 'policy entrepreneurs' (Keck and Sikkink 1998; Mintrom and Vergari 1996), these experts warned against 'complacency' in the fight against 'bacterial, viral, protozoal, helminthic, and fungal invaders' (Lederberg *et al*. 1992: 16).

> As the human immunodeficiency virus (HIV) disease pandemic surely should have taught us, in the context of infectious diseases, there is nowhere in the world from which we are remote and no one from whom we are disconnected. Consequently, some infectious diseases that now affect people in other parts of the world represent potential threats to the United States because of global interdependence, modern transportation, trade, and changing social and cultural patterns.
>
> (Lederberg *et al*. 1992: v)

It was this report that provided a coherent, highly authoritative and novel narrative of a future shaped by emerging infectious diseases (EID) (Lakoff 2015).

The report advocated and promoted a particular concept of emerging infectious diseases, which has since gained hold in the scientific medical discourse. It distinguishes between two categories: those previously unknown pathogens that

are discovered and recognized in humans for the first time (newly emerging); and those that are known to have infected humans before but appear today in different locations or as a new (potentially drug-resistant) strain or reemerge after apparent elimination (Heymann and West 2014; Morens and Fauci 2013). Since the conditions and circumstances under which pathogens develop and transform are highly complex, 'the emergence of novel pandemic agents often seems to be inherently unpredictable', while the frequency of new emergences is increasing, Morse *et al*. (2012: 2) warn (see also Holmes *et al*. 2018). As a result, predicting a major disease outbreak is still in an early stage – despite the enormous progress that has been made in big data analytics, digitalization and AI (artificial intelligence) in recent years (Flahault *et al*. 2017; Vayena *et al*. 2018) – because it depends on the interaction of a large number of complex factors at the animal–human interface (Morse 2012; Morse *et al*. 2012; Neumann and Kawaoka 2019). Reflecting this uncertainty, the generic concept of emergence emphasizes 'potentiality': The disease 'can pass over or not pass over into actuality' (Weir and Mykhalovskiy 2010: 40).

In the following years, two disease outbreaks added further urgency to these warnings: First, the 1995 Ebola outbreak in Kikwit (then Zaire) created a globally mediated fear (at times marked by racist undertones) of deadly pathogens lying dormant in the 'impenetrable jungle' of 'backward' countries (King 2004, 2015). Second, in 2002/03, the SARS pandemic seemed to prove the EID-concept: Within just a few weeks, a severe respiratory disease spread along heavily frequented flight routes from Hong Kong to Singapore, Toronto and Vietnam, rapidly affecting more than 8,000 people across five continents: A patient from China's Guangdong province had travelled to Hong Kong for a wedding, where he infected other guests, who in turn transmitted the infection as they continued on their journeys. Epidemiological investigations later showed that wild-game animal markets in Southern China might have provided 'the interface which facilitated the maintenance and amplification of SARS-CoV precursor viruses, allowing repeated exposure of the human population and leading to inter-species transmission events' (Hilgenfeld and Peiris 2013: 288).

The popularization of the EID concept was further enabled and facilitated by broader societal and political developments: The new awareness of emerging diseases coincided with a heightened concern about bioterrorism and biological warfare that evolved (mainly in the US, Japan and Europe) in the 1990s and, even more pronouncedly, after the terrorist attacks of September 2001, conflating medicine and national security under the rubric of biosecurity (Cooper 2008: 74–81; Falkenrath *et al*. 1998). Furthermore, the reconceptualization and broadening of the concept of 'security' both in scholarly and military circles in the 1990s facilitated an integration of a wider set of (military and non-military) issues into states' security agendas (Krause and Williams 1997). This 'securitization' of health contributed to a framing of pandemics and infectious diseases as potentially existential threats – which cannot be solved by routine measures of global public health, but need a 'decisive', forceful and exceptional (yet permanent) reaction (Aldis 2008; Elbe 2010). And lastly, the fear from intangible

pathogens spreading globally and uncontrollably in an interconnected, seemingly borderless world resonated well with new notions of 'risks of modernity' that became popular in the early 1990s (Beck 1986): According to this view, growing and intensifying processes of globalization and connectivity in trade and travel not only spur the global spread of pathogens and diseases, but also reduce the advance warning time for state actors to protect their citizens, leaving them potentially unguarded and unprepared against newly emerging health threats.

The topic also blurred the lines between sober scientific analysis and fictional dramatization: Horrifying scenarios of a hitherto unknown and unimaginable pathogenic menace to humanity made their way into mass media, bestselling books and Hollywood movies (cf. Aaltola 2012; King 2002, 2004; Wald 2008). Several (both science and fiction) authors predicted the breakdown of functioning economic, political and societal structures should a deadly pandemic of 'superbugs' and 'killer microbes' emerge (Garrett 1995; Preston 1995). Others hypothesized that an

> epidemic disease may function as a stressor variable to compromise the prosperity, the legitimacy, the structural cohesion, and in certain cases the security of sovereign states. Further, diseases may exacerbate pre-existing domestic conflicts between ethnicities, and/or classes and may generate intra-societal and intra-state violence, and the resulting societal discord may generate punitive and draconian responses by the state against its people as it seeks to maintain order.
>
> (Price-Smith 2009: 3–4)

In a similar vein, WHO declared pandemic influenza 'the most feared security threat' (quoted in Enemark 2009: 191). And the so-called Spanish Flu of 1918, which might have killed up to 50 million people worldwide according to some accounts, became commonly referenced as scary evidence of the apocalyptic potential of such viruses (Garrett 2005). Together, these interpretations and prophecies contributed to a new perception of the pathogenic dangers surrounding 'us' and paved the way for the acceptance and sedimentation of the 'emerging infectious disease' worldview in academia and beyond.[4]

Later CDC and IoM reports repeated the depiction of the threat and pushed for a global leadership role of the CDC as well as US research institutes and pharmaceutical companies. King claims that the CDC aspired to be 'the source of the technology, standards and expertise, creating the computer models and risk-analysis software, furnishing regional laboratories with "state of the art" diagnostics, and training foreign personnel', in order to be able to shape the global health order (King 2002: 775; see also Weir and Mykhalovskiy 2010: 29–40). Indeed, the notion of emerging diseases put forward by the CDC soon acquired authority and political traction. It provided a central scientific impulse for an overhaul of WHO's tasks and procedures in the case of a communicable disease outbreak and of global health governance more generally.

The following paragraphs will show that this resulted in structural and organizational adjustments, which were accompanied by an epistemological shift: Based on an altered socio-technical imaginary of life in an unknown 'pathogenic future', WHO's traditional task of repelling and containing a few specific, defined health threats was replaced by a precautionary approach for anticipating and governing uncertainty. This development was facilitated by the massive rise of digital health technologies and artificial intelligence that allows for the generation, collection and analysis of huge amounts of – both structured and unstructured – health data on a global level.

Reforming global health governance: from risk to uncertainty

Initiated in 1995, the WHO reform process came to a conclusion in 2005 with the adoption of the new International Health Regulations (IHR 2005: WHO 2005b). The most important aspect of the reform process pertains to the scope of the regulations. Unlike earlier guidelines, the IHR 2005 do not merely contain a list of identified, reportable diseases, but introduce the notion of 'disease event': States are no longer obliged only to report a small number of specific diseases, but also to install on their territory a comprehensive surveillance system, a 'vigilance apparatus' (Weir and Mykhalovskiy 2010) capable of immediately detecting all those public health 'events' that have the potential to spread beyond local areas. 'Each State Party shall notify WHO […] of all events which may constitute a public health emergency of international concern within its territory' (WHO 2005a: Art. 6.1). A reportable 'event' is no longer solely defined on the basis of specific, identifiable pathogens (and diagnosed illnesses), but based on syndromes and scale ('is the impact serious?'), thereby making the scope of the application much broader and more flexible.

In order to detect all relevant events, all member states are obliged to implement a state-wide system ('functioning throughout their territories', i.e. at national, intermediate and community level) to monitor, detect and react to a potential 'Public Health Emergency of International Concern' (PHEIC). As stipulated in the new regulations, 'each state party shall develop, strengthen and maintain […] the capacity to detect, assess, notify and report events' (WHO 2005a: Art 5.1).

This entails that states institutionalize at a local or primary public health response level a comprehensive and permanent surveillance infrastructure in order to be able to collect the following event-related information: 'clinical descriptions, laboratory results, sources and type of risk, numbers of human cases and deaths, conditions affecting the spread of the disease and the health measures employed' (WHO 2005a: Annex 1). At the national level, capacities need to be in place 'to assess all reports of urgent events within 48 hours' and 'to notify WHO immediately through the National IHR Focal point when the assessment indicates the event is notifiable' (WHO 2005a: Annex 1). Moreover, the new regime calls for rather specific response mechanisms (available on a 24-hour basis) to be set in place by governments. This includes, for example, the establishment of a national public health emergency response plan; specialized

multidisciplinary response teams; logistical, technical and personnel on-site assistance to local staff, laboratory facilities; and communication links between different levels and actors (Fidler 2005; Lakoff 2015).

The new regulations also strengthen the role of non-state actors – such as the media, humanitarian nongovernmental organizations, local medical workers, or activists – in disease reporting and they grant WHO more authority in declaring a PHEIC, even without prior consent by the affected state. This extension of epidemic information sourcing beyond traditional (national) public health authorities has been one of the most important changes in recent years: Today, more than 60 per cent of the initial outbreak reports come from unofficial or informal sources.

> Recognizing implicitly the poor performance of formal surveillance systems (i.e. those based on traditional public health infrastructures), WHO has been broadening the data source base for global surveillance by incorporating informal sources of information such as: the mass media, electronic discussion groups, non-governmental and faith-based organizations.
>
> (Calain 2007: 16; see also Davies *et al*. 2015)

Recent, unprecedented advances in the realms of digital health, information technology and artificial intelligence (AI) have fundamentally improved the necessary conditions for global surveillance and made the early detection of infectious diseases far more feasible. In addition to the increased use of electronic medical records, which collect individual health data in a digital form (instead of traditional paper-based records) and speed up the transmission and (if necessary) population-wide analysis of diagnostic results, there is now a number of digital, AI-based notification systems. Applications such as ProMed Mail, the Global Public Health Intelligence Network (GPHIN), Argus, GOARN, HealthMap and others contribute to what WHO calls 'epidemic intelligence' – i.e. the collection of vast amounts of structured and unstructured health-related data. Some of these primarily facilitate the development of a global epistemic community of epidemiologists and disease experts and help to collect and verify information about potential outbreaks. Others for example draw on artificial intelligence and machine learning to detect outbreak patterns: They systematically search and scan publicly available internet sources such as newspapers, radio and TV stations for a large number of disease-related key words to detect patterns that indicate suspicious disease events. The latter tools share two general characteristics: They account for both predefined and unspecified disease events and the occurrence of suspicious syndromes rather than only for known diseases and confirmed laboratory diagnostics; and they circumvent traditional hierarchical information processing of healthcare institutions by using a more network-centric approach based on the collection, analysis and filtering of internet big data, thereby allowing for near real-time disease surveillance.

The fate of Google's highly praised and ambitious Flu Trends project, however, is a cautionary tale against premature expectations: The algorithm-based application was built upon the assumption that non-ordinary health events such as

a flu epidemic are likely to be reflected in people's internet search queries, as those who are affected would search for symptoms, GPs and pharmacies nearby, drugs and the like. Hence, if one could develop an algorithm that would detect increases in those disease-related google searches, one would be able to picture the unfolding disease. 'Unfortunately, Google Flu Trends faltered when it mattered the most, completely missing the onset in April 2009 of the H1N1 pandemic. The algorithm also ran into trouble later on in the pandemic' (Eisenstein 2018). While the algorithm was trained to account for seasonal variations, it did not foresee 'the human component' – i.e. how media coverage and the arising fear of a coming flu would significantly alter people's search behaviour. Moreover, cultural and language barriers often complicate the use of unstructured data, as Moran *et al*. (2016: 406) describe:

> The simplest approach for extracting information from unstructured data, such as tweets, is the bag-of-words approach, in which the frequencies of certain words (or posts containing said words) are tallied. The downfall to this approach is its inability to infer context; the bag-of-words approach cannot tell 'That guy on the bus coughed all over me, and now I have a fever' from 'That concert gave me raging Bieber fever' ...

... a condition affecting predominantly teenage fans of the eponymous pop star.

The global politics of anticipative medicalization

The new international health regulations were designed and implemented to enable 'real-time' detection of (unknown) disease outbreaks by establishing a global disease surveillance and response architecture. Yet the changes go beyond mere institutional adjustments and organizational reforms. Unlike traditional public health measures, which rely on the calculation and assessment of risks and risk factors based on scientific insights on disease etiology and transmission, the new apparatus also targets the unknown, the emergent. The EID concept

> defines infectious disease as *emerging* and *emergent* – not incidentally, but *in essence*. What public health policy needs to mobilize against, the new microbiology argues, is no longer the singular disease with its specific etiology, but *emergence itself*, whatever form it takes, whenever and wherever it happens to actualize.
>
> (Cooper 2008: 80 (emphasis in the original))

The search for outbreaks of known diseases has thus been replaced by the 'aim to recognize abnormal morbidity before knowing what type of morbidity it is, before identifying the disease or its causes' (Samimian-Darash 2013). Introducing the rather vague concept of 'event' was critical in this regard: The term subsumes outbreaks with known causes and those that are initially unexplainable.

This greatly extends the 'radar' of disease surveillance and decouples it from the search for the known.

As indicated, the traditional regime of disease control established in previous international health regulations was replaced by a precautionary 'governance of uncertainty' approach that allows to deal in 'real time' with the emergence of the previously unknown (Figuié 2014). This reflects a significant epistemological change, since it replaces calculations of risks and known disease threats by an emphasis of future uncertainty (with regard to the pathogenic cause and the characteristics of its emergence). Anticipative action is no longer only legitimated on the basis of known, specific threats, but also on the basis of what experts anticipate to potentially materialize. Even more so, it is the very anxiety of the unknown and the perception of a looming future emergency that provide the justification for the establishment of a new mechanism for governing global public health (and vital systems more broadly, as argued by Collier and Lakoff 2015; see also Lentzos and Rose 2009: 247). Ultimately, what we see in the realm of global health is thus the formation of a new 'socio-technical imaginary' (Jasanoff 2015): a publicly shared, institutionally anchored perception of future social life and social order in a world that is characterized by new and uncertain pathogenic developments. This imaginary enabled an 'anticipative medicalization' and justified the construction of a comprehensive global network of big data-driven diagnostic and surveillance technologies.

The reform of WHO's health regulations and institutional response structures has drawn praise from many observers. It was lauded for creating a more effective and efficient system of global health surveillance that better allows to govern the future in global health and to deal with the eventualities of newly emerging diseases (Fidler and Gostin 2006). Less attention has been paid, however, to how the new imaginary also impacts upon and co-constitutes the contemporary sociopolitical and medical order. For example, the significance of the concept of 'Emerging Infectious Disease' is more contested than one might assume. Some authors claim that it is primarily a concern for the western world, while the larger part of the global population suffers rather from a lack of or insufficient sanitary infrastructure, clean water, proper nutrition or from unsatisfactory access to essential medicines. Weir, for example, even asserts that the IHR regime is questionable from a global justice perspective, since the global health security apparatus

> mainly acts to prevent the diseases of the poor people in the South from spreading to the North and laterally to other areas in the South. Bracketing off endemic diseases to construct the domain of global health security is a constitutive exclusion that violates the principles of cosmopolitanism and borderlessness.
>
> (Weir 2015: 27)

The 'harvest of outbreak intelligence overseas is essentially geared to benefit the wealthy nations', as one writer puts it (Blouin Genest 2015; Calain 2007: 19; see also McInnes and Lee 2006).

The virus-sharing controversy between Indonesia and the WHO in 2006 sheds light on a related aspect of this conflict: During the avian (H5N1) influenza outbreak, the country refused to share virus samples with the WHO, complaining that the organization would pass the specimen on to the pharmaceutical industry which would then use it for developing, patenting and selling vaccines without making them also available to less affluent states. This radical move was heavily criticized by many policy-makers and scientists all over the globe and especially in industrialized states (but also backed by many low- and middle-income countries), since it

> threw a sizeable spanner into the global pandemic preparedness machinery because Indonesia was, in many ways, at the 'forefront' of a possible H5N1 pandemic, reporting the highest numbers of human cases and deaths of H5N1 infection up to that point in time. Without access to the viruses circulating within Indonesia's territorial borders, it was no longer possible for the international public health community to acquire comprehensive surveillance data about how the virus was evolving, nor to develop stockpiles of up-to-date candidate vaccines based on the more virulent Indonesian virus strands.
>
> (Elbe 2010: 479; see also Lakoff 2015)

Yet, Indonesia's complaint was not unfounded, other observers maintained. Even the WHO warned that global vaccine production levels were far from sufficient to secure global immunization in times of an influenza pandemic: 'The greatest problem is inadequate production capacity. Demand will unquestionably outstrip supply, particularly at the start of a pandemic' (WHO 2005a: 48). With most vaccine producers being located in the industrialized states of the world, it is easy to infer who would be left standing in case of a global health crisis. Granting all states equal access to the benefits of EID control is a fundamental concern in debates about global health justice.

Contestations of the current conceptualization of EID thus reflect broader struggles over health priorities and resource allocation between western industrialized states and the global South (Weir and Mykhalovskiy 2010: 57). In this vein, critics point to the social and economic causes of pandemics, which, they maintain, are disregarded under the IHR 2005 approach (Keil *et al*. 2011). Relatedly, it has been pointed out that the focus on emerging and reemerging diseases must not distract already scarce resources from long-term, horizontal investments in basic healthcare improvements and disease prevention measures in many states of the South (Calain 2007; Rushton 2011). It is in this spirit that the Director General of WHO, Tedros Adhanom Ghebreyesus, demands to increase efforts at achieving universal health coverage globally:

> Universal health coverage and health emergencies are cousins – two sides of the same coin. Strengthening health systems is the best way to safeguard

> against health crises. Outbreaks are inevitable, but epidemics are not. Strong health systems are our best defence to prevent disease outbreaks from becoming epidemics.
>
> (Ghebreyesus 2017: 839)

Finally, even under the revised IHR and despite the massive advances in digital healthcare and AI, the early assessment of an event's coming pandemic potential remains fraught with uncertainties and intricate decision-making constraints, as the WHO's handling of the H1N1-pandemic in 2009 illustrates: The virus, which is usually only found in pigs, spread rapidly from residents of a Mexican village to the US, Canada and eventually across the globe, and soon prompted horror scenarios of the long-feared deadly pandemic. Triggered by the emergency management of WHO, which declared the outbreak a pandemic of the highest alert level, many wealthier states soon began to procure and store millions of doses of antiviral medication (e.g. 'Tamiflu'). Eventually, the epidemic turned out to be less severe than expected, leading to sharp criticism of the organization's decision-making (Davies and Youde 2015; Doshi 2011; Keil *et al*. 2011; Lakoff 2015).

This episode indicates that the anticipation of 'future health', i.e. the trajectory of emerging diseases is 'subjected not only to the epistemic uncertainties of predictive knowledge, but also to political and economic constraints and imperatives, local and international contexts, the individual experience of risk managers and the availability of control options' (Seetoh *et al*. 2012: 49) – and it is also subjected to decision-makers seeking to 'manage the risks of being wrong about risks' (Dunn Cavelty 2020). Governing the future, whether in health or other policy fields, is thus never merely a value-free, rational assessment of factual knowledge. Instrumental reasons, interests and policy-agendas also come into play, when experts, politicians and decision-makers pick from and act upon a range of possible future health scenarios. Whether false alarms and inflated scares will lead to 'contagion exhaustion' (Osterholm 2013) and diminished alertness remains to be seen. Perhaps it is, to the contrary, even an essential feature of pandemic prophecies that they are always 'on the verge of happening', as Caduff writes: 'In the prophetic scene, people are constantly confronted with the never-quite-arriving point of the disease, a disease that remains on the horizon as a dark prospect' (Caduff 2015: 23).

Conclusion

Because of the fragility and finitude of human life, the desire to envision and control our future health and physical integrity is perhaps particularly urgent and deep. The examples presented in this chapter suggest that we are currently witnessing an increasing anticipative medicalization of life: an expansion of diagnostic and surveillance technologies designed to facilitate the governing and management of imminent or future illnesses. This development is strongly interlinked with the rise of big data, digital technologies and AI in healthcare,

which allow for the massive collection, processing and analysis of structured and unstructured health data on an individual as well as on a population-wide level.

With regard to personal health, the novel tools of testing and engineering have spurred a fundamentally new perception of genetic inheritance and genetic potentiality and have grown from a niche-tool to a standard application for clinical and lifestyle purposes in wealthy societies. Individuals are now increasingly encouraged and perhaps even impelled to find out their genetic health risks and to manage their bodies and reproductive choices accordingly and preventively. How the prediction and management of risks will play out in future biopolitics and whether this will lead to a manifest moral or economic imperative to behave like a 'good genetic citizen' is not yet readily visible. Likewise, many ethical questions remain regarding data ownership, security and access. Biotechnological progress has been so fast and far-reaching, though, that states' attempts to regulate and govern these new technologies as well as the societal discourse on their implications, are repeatedly outpaced.

On the global level, envisioning future health plays out differently, since research on the precise prediction of communicable disease outbreaks is still in an early stage. And yet, we can observe a similar trend towards data-driven anticipative medicalization: Facilitated by the unparalleled advances in digital health and AI and the vast increase in health data that is generated today, the lauded IHR-system of communicable disease surveillance helps to detect disease outbreaks of international concern in real-time. Arguably, the novel mechanisms that move the governing of uncertainty centre stage are not limited to the specific handling of certain diseases, but leave a strong imprint on the present global health order: As an analysis of the regulations shows, governing the potential future event is now as important as the management and mitigation of already existing challenges. The IHR 2005 reflect the assumption that it is not necessarily the long-known diseases that present the severest danger, but that the public must be equally protected from the 'unknown' and the 'newly emerging' that can happen anytime.

A specific vision of the future has thus become one of the crucial reference points for shaping current structures of global public health policy. The case of the health regulations exemplifies, how a new scientific imaginary of the future gained authority and consequently was applied to negotiate and establish a new order for the effective governance of global public health. But in global public health, too, many ethical questions remain: Who owns the health data – ranging from data collected through electronic medical records, diagnostic tests, clinical trials, wearables or mobile devices to environmental and geospatial data? How can we make sure that commercial business models do not preclude data use for public health purposes? How can we bridge the still existing digital divide? How can data misuse, privacy breaches and fraud be prevented? How can we reconcile the rights and interests of different stakeholders – for example of individuals, public health and state authorities, business companies? How can we guarantee that the benefits of the new technological advances are distributed

equally across the globe? Since the current move towards big data, digitalization and AI happens at such fast speed, many states lack the capacities and the expertise to develop needed regulatory frameworks. Global efforts will thus be needed to make sure that the technologies to govern the emerging 'health future' are implemented responsibly.

Even though the mechanisms and procedures at the individual and the global level diverge, they seem to be driven by a larger, unifying imaginary that appears characteristic for our dealings with life in the twenty-first century: a growing desire to anticipate and reign over our future health by augmenting the scope, functionality and applicability of biotechnological tools and practices of predictive diagnostics and surveillance.

Notes

1 Work on this chapter was completed before the emergence of Covid-19.
2 Conrad and Waggoner introduced the term 'anticipatory medicalization', but their usage differs from the one I suggest here: They are primarily concerned with the broadening of medical conditions and their underlying definitions which lead to an increase in the number of patients being diagnosed and treated for a specific disorder, while I address the expansion of predictive and surveillance techniques for covering future health eventualities (Conrad and Waggoner 2017). Elbe, on the other hand, uses the term 'medicalization' (of insecurity) to describe how medical reason is increasingly applied to issues of international and global security (Elbe 2012).
3 While this chapter focuses on genetic testing and diagnostics in individual health, the turn towards prediction of individual disease risks is not limited to this realm. There are now abundant examples that indicate the potential of predictive tools if they are combined with the large amounts of regularly collected population-wide medical data. For instance, in Israel – a pioneer in the application of digital technologies in healthcare – large-scale 'predictive data mining' based on algorithms is already used by health insurance companies to search for and identify disease patterns and risk distributions among groups or to individualize and specify therapeutic interventions to single patients based, for instance, on calculated risks due to secondary conditions (Balicer and Afek 2017). The combination of large amounts of data and predictive algorithms enables insurers to specifically predict the risk of individual applicants and to design more precise risk classification (and payment schemes) systems for the insured. At the same time such tools allow to incentivize 'good behaviour' (and penalize unhealthy lifestyles) based on calculated preconditions and risks of falling ill.
4 Why these pandemic prophecies became particularly appealing and authoritative in the US context goes beyond the confines of this chapter. Caduff makes a convincing argument, though, that notions of a looming existential threat are deeply anchored in a long tradition of apocalyptic thought that remains present in the American history of ideas (Caduff 2015: 5).

References

Aaltola, M. (2012) *Understanding the Politics of Pandemic Scares: An Introduction to Global Politosomatics*, London and New York: Routledge.

Akabayashi, A. (ed.) (2014) *The Future of Bioethics: International Dialogues*, Oxford: OUP.
Aldis, W. (2008) 'Health Security as a Public Health Concept: A Critical Analysis', *Health Policy and Planning* 23(6): 369–75.
Balicer, R. D. and Afek, A. (2017) 'Digital Health Nation: Israel's Global Big Data Innovation Hub', *The Lancet* 389(10088): 2451–3.
Beck, U. (1986) *Risikogesellschaft: Auf dem Weg in eine andere Moderne*, Frankfurt am Main: Suhrkamp.
Blouin Genest, G. (2015) 'World Health Organization and Disease Surveillance: Jeopardizing Global Public Health?', *Health* 19(6): 595–614.
Braun, B. (2007) 'Biopolitics and the Molecularization of Life', *Cultural Geographies* 14(1): 6–28.
Caduff, C. (2014) 'On the Verge of Death: Visions of Biological Vulnerability', *Annual Review of Anthropology* 43: 105–21.
Caduff, C. (2015) *The Pandemic Perhaps: Dramatic Events in a Public Culture of Danger*, Oakland: University of California Press.
Calain, P. (2007) 'From the Field Side of the Binoculars: A Different View on Global Public Health Surveillance', *Health Policy and Planning* 22(1): 13–20.
Clarke, A. E., Shim, J. K., Mamo, L., Fosket, J. R. and Fishman, J. R. (2003) 'Biomedicalization: Technoscientific Transformations of Health, Illness, and US Biomedicine', *American Sociological Review* 68: 161–94.
Collier, S. J. and Lakoff, A. (2015) 'Vital Systems Security: Reflexive Biopolitics and the Government of Emergency', *Theory, Culture and Society* 32(2): 19–51.
Conrad, P. (2008) *The Medicalization of Society: On the Transformation of Human Conditions into Treatable Disorders*, Baltimore: Johns Hopkins University Press.
Conrad, P. and Waggoner, M. (2017) 'Anticipatory Medicalization', in M. Bondio Gadebusch, F. Sporing and J.-S. Gordon (eds) *Medical Ethics, Prediction, and Prognosis: Interdisciplinary Perspectives*, London: Routledge, 95–103.
Cooper, M. (2008) *Life as Surplus: Biotechnology and Capitalism in the Neoliberal Era*, Seattle: University of Washington Press.
Davies, S. E. and Youde, J. R. (eds) (2015) *The Politics of Surveillance and Response to Disease Outbreaks: The New Frontier for States and Non-State Actors*, Farnham: Ashgate.
Davies, S. E., Kamradt-Scott, A. and Rushton, S. (2015) *Disease Diplomacy: International Norms and Global Health Security*, Baltimore: Johns Hopkins University Press.
Davis, J. E. (2006) 'How Medicalization Lost Its Way', *Society* 43(6): 51–6.
Doshi, P. (2011) 'The Elusive Definition of Pandemic Influenza', *Bulletin of the World Health Organization* 89(7): 532–8.
Dunn Cavelty, M. (2020) 'From Predicting to Forecasting: Uncertainties, Scenarios and their (Un)Intended Side Effects', in A. Wenger, U. Jasper and M. Dunn Cavelty (eds) *Probing and Governing the Future: The Politics and Science of Prevision*, London and New York: Routledge, 89–103.
Eisenstein, M. (2018) 'Infection Forecasts Powered by Big Data', *Nature* 555(7695): 2–4.
Elbe, S. (2010) 'Haggling over Viruses: The Downside Risks of Securitizing Infectious Disease', *Health Policy and Planning* 25(6): 476–85.
Elbe, S. (2012) 'Bodies as Battlefields: Toward the Medicalization of Insecurity', *International Political Sociology* 6(3): 320–2.
Elshtain, J. B. (2005) 'The Body and the Quest for Control', in H. W. Baillie and T. K. Casey (eds) *Is Human Nature Obsolete? Genetics, Bioengineering, and the Future of the Human Condition*, Cambridge, MA: MIT Press, 155–75.

Enemark, C. (2009) 'Is Pandemic Flu a Security Threat?', *Survival* 51(1): 191–214.

Falkenrath, R. A., Newman, R. D. and Thayer, B. A. (1998) *America's Achilles' Heel: Nuclear, Biological, and Chemical Terrorism and Covert Attack*, Cambridge, MA: MIT Press.

Feuerstein, G. and Kollek, R. (2001) 'Vom genetischen Wissen zum sozialen Risiko: Gendiagnostik als Instrument der Biopolitik', *Aus Politik und Zeitgeschichte. Beilage zur Wochenzeitung 'Das Parlament'* 27(01): 26–33.

Fidler, D. P. (2005) 'From International Sanitary Conventions to Global Health Security: The New International Health Regulations', *Chinese Journal of International Law* 4(2): 325–92.

Fidler, D. P. and Gostin, L. O. (2006) 'The New International Health Regulations: An Historic Development for International Law and Public Health', *The Journal of Law, Medicine and Ethics* 34(1): 85–94.

Figuié, M. (2014) 'Towards a Global Governance of Risks: International Health Organisations and the Surveillance of Emerging Infectious Diseases', *Journal Of Risk Research* 17(4): 469–83.

Flahault, A., Geissbuhler, A., Guessous, I., Guérin, P., Bolon, I., Salathé, M. and Escher, G. (2017) 'Precision Global Health in the Digital Age', *Swiss Medical Weekly* 147: 1–5

Foucault, M. (2003) 'Die Geburt der Sozialmedizin (Vortrag)', in D. Defert and F. Ewald (eds) *Michel Foucault: Schriften in vier Bänden, Dits et Ecrits*, Frankfurt am Main: Suhrkamp, 272–98.

Garrett, L. (1995) *The Coming Plague: Newly Emerging Diseases in a World out of Balance*, Eleventh printing, New York: Farrar.

Garrett, L. (2005) 'The Next Pandemic?', *Foreign Affairs* 84(4): 3–23.

Ghebreyesus, T. A. (2017) 'All Roads Lead to Universal Health Coverage', *The Lancet Global Health* 5(9): e839–e840.

Habermas, J. (2002) *Die Zukunft der menschlichen Natur: Auf dem Weg zu einer liberalen Eugenik?*, 4th expanded ed., Frankfurt am Main: Suhrkamp.

Hacking, I. (1990) *The Taming of Chance*, Reprinted ed., Cambridge: Cambridge University Press.

Heymann, D. L. and West, A. (2014) 'Threats to Health and Economic Security', in S. Rushton and J. Youde (eds) *Routledge Handbook of Global Health Security*, Milton Park: Routledge, 92–104.

Hilgenfeld, R. and Peiris, M. (2013) 'From SARS to MERS: 10 Years of Research on Highly Pathogenic Human Coronaviruses', *Antiviral Research* 100(1): 286–95.

Holmes, E. C., Rambaut, A. and Andersen, K. G. (2018) 'Pandemics: Spend on Surveillance, not Prediction', *Nature Publishing Group*, 7 June. Online. Available: www.nature.com/articles/d41586-018-05373-w (accessed 30 July 2019).

Jasanoff, S. (2015) 'Future Imperfect: Science, Technology, and the Imaginations of Modernity', in S. Jasanoff and S.-H. Kim (eds) *Dreamscapes of Modernity: Sociotechnical Imaginaries and the Fabrication of Power*, Chicago: University of Chicago Press, 1–33.

Jolie, A. (2013) 'My Medical Choice', *The New York Times*, 14 May. Online. Available: www.nytimes.com/2013/05/14/opinion/my-medical-choice.html (accessed 30 July 2019).

Kamenova, K., Reshef, A. and Caulfield, T. (2014) 'Angelina Jolie's Faulty Gene: Newspaper Coverage of a Celebrity's Preventive Bilateral Mastectomy in Canada, the United States, and the United Kingdom', *Genetics in Medicine* 16(7): 522–8.

Katsanis, S. H. and Katsanis, N. (2013) 'Molecular Genetic Testing and the Future of Clinical Genomics', *Nature Reviews Genetics* 14(6): 415–26.

Keck, M. E. and Sikkink, K. (1998) *Activists Beyond Borders: Advocacy Networks in International Politics*, Ithaca, NY: Cornell University Press.

Keil, U., Schönhöfer, P. and Spelsberg, A. (2011) 'The Invention of the Swine-Flu Pandemic', *European Journal of Epidemiology* 26(3): 187–90.

King, N. B. (2002) 'Security, Disease, Commerce: Ideologies of Postcolonial Global Health', *Social Studies of Science* 32(5–6): 763–89.

King, N. B. (2004) 'The Scale Politics of Emerging Diseases', *Osiris* 19: 62–76.

King, N. B. (2015) 'Mediating Panic: The Iconography of "New" Infectious Threats, 1936–2009', in R. Peckham (ed.) *Empires of Panic: Epidemics and Colonial Anxieties*, Hong Kong: Hong Kong University Press, 181–208.

Krause, K. and Williams, M. C. (eds) (1997) *Critical Security Studies: Concepts and Cases*, London: Routledge.

Lakoff, A. (2015) 'Global Health Security and the Pathogenic Imaginary', in S. Jasanoff and S. H. Kim (eds) *Dreamscapes of Modernity: Sociotechnical Imaginaries and the Fabrication of Power*, Chicago: University of Chicago Press, 300–20.

Lederberg, J., Shope, R. E. and Oaks Jr, S. C. (1992) *Emerging Infections: Microbial Threats to Health in the United States*, Washington, D.C.: National Academies Press.

Lentzos, F. and Rose, N. (2009) 'Governing Insecurity: Contingency Planning, Protection, Resilience', *Economy and Society* 38(2): 230–54.

Mayer, J. D. (2000) 'Geography, Ecology and Emerging Infectious Diseases', *Social Science and Medicine* 50(7): 937–52.

McInnes, C. and Lee, K. (2006) 'Health, Security and Foreign Policy', *Review of International Studies* 32(01): 5–23.

McInnes, C., Kamradt-Scott, A., Lee, K., Roemer-Mahler, A., Rushton, S. and Williams, O. D. (2014) 'Pandemic Influenza', in C. McInnes *et al*. (eds) *The Transformation of Global Health Governance*, Basingstoke: Palgrave Macmillan, 41–58.

Mintrom, M. and Vergari, S. (1996) 'Advocacy Coalitions, Policy Entrepreneurs, and Policy Change', *Policy Studies Journal* 24(3): 420–34.

Moran, K. R., Fairchild, G., Generous, N., Hickmann, K., Osthus, D., Priedhorsky, R., Hyman, J. and Del Valle, S. Y. (2016) 'Epidemic Forecasting is Messier than Weather Forecasting: The Role of Human Behavior and Internet Data Streams in Epidemic Forecast', *Journal of Infectious Diseases* 214(4): 404–8.

Morens, D. M. and Fauci, A. S. (2013) 'Emerging Infectious Diseases: Threats to Human Health and Global Stability', *PLoS Pathog* 9(7): e1003467.

Morse, S. S. (2012) 'Public Health Surveillance and Infectious Disease Detection', *Biosecurity and Bioterrorism: Biodefense Strategy, Practice, and Science* 10(1): 6–16.

Morse, S. S., Mazet, J. A. K., Woolhouse, M., Parrish, C. R., Carroll, D., Karesh, W. B., Zambrana-Torrelio, C., Lipkin, I. and Daszak, P. (2012) 'Prediction and Prevention of the Next Pandemic Zoonosis', *The Lancet* 380(9857): 1956–65.

NCBI (National Center for Biotechnology Information) (2018) 'Genetic Testing Registry', *National Center for Biotechnology Information Search Database.* Online. Available: www.ncbi.nlm.nih.gov/gtr (accessed 30 July 2019).

Neumann, G. and Kawaoka, Y. (2019) 'Predicting the Next Influenza Pandemics', *The Journal of Infectious Diseases* 219(1): 14–20.

Nill, A., Laczniak, G. and Thistle, P. (2017) 'The Use of Genetic Testing Information in the Insurance Industry: An Ethical and Societal Analysis of Public Policy Options', *Journal of Business Ethics* 156(1): 105–21.

Nye, R. A. (2003) 'The Evolution of the Concept of Medicalization in the Late Twentieth Century', *Journal of the History of the Behavioral Sciences* 39(2): 115–29.

Osterholm, M. T. (2013) 'The Next Contagion: Closer Than You Think, Op-Ed', *New York Times*, 9 May, Online. Available: www.nytimes.com/2013/05/10/opinion/the-next-contagion-closer-than-you-think.html (accessed 30 July 2019).

Preston, R. E. (1995) *The Hot Zone*, New York: Anchor Books.

Price-Smith, A. T. (2009) *Contagion and Chaos: Disease, Ecology, and National Security in the Era of Globalization*, Cambridge, MA: MIT Press.

Rose, N. (2001) 'The Politics of Life Itself', *Theory, Culture and Society* 18(6): 1–30.

Rushton, S. (2011) 'Global Health Security: Security for Whom? Security from What?', *Political Studies* 59(4): 779–96.

Samimian-Darash, L. (2013) 'Governing Future Potential Biothreats: Toward an Anthropology of Uncertainty', *Current Anthropology* 54(1): 1–22.

Sandel, M. J. (2007) *The Case against Perfection: Ethics in the Age of Genetic Engineering*, Cambridge, MA: The Belknap Press of Harvard University Press.

Seetoh, T., Liverani, M. and Coker, R. (2012) 'Framing Risk in Pandemic Influenza Policy and Control', *Global Public Health* 7(7): 717–30.

Tulchinsky, T. H. and Varavikova, E. A. (2009) *The New Public Health*, London: Elsevier Academic Press.

Vayena, E., Dzenowagis, J., Brownstein, J. S. and Sheikh, A. (2018) 'Policy Implications of Big Data in the Health Sector', *Bulletin of the World Health Organization* 96(1): 66.

Wald, P. (2008) *Contagious: Cultures, Carriers, and the Outbreak Narrative*, Durham: Duke University Press.

Weir, L. (2015) 'Inventing Global Health Security, 1994–2005', in S. Rushton and J. Youde (eds) *The Routledge Handbook of Global Health Security*, Abingdon: Routledge, 18–31.

Weir, L. and Mykhalovskiy, E. (2010) *Global Public Health Vigilance: Creating a World on Alert*, Abingdon: Routledge.

World Health Assembly (1951) *International Sanitary Regulations*, Geneva: World Health Organization.

WHO (World Health Organization) (2005a) *Avian Influenza: Assessing the Pandemic Threat*, Geneva: World Health Organization.

WHO (World Health Organization) (2005b) *International Health Regulations (2005)*, Geneva: World Health Organization Press.

9 Crisis, what crisis?

Uncertainty, risk, and financial markets[1]

Stephen C. Nelson and Peter J. Katzenstein

Financial crises are destructive; the near collapse of the American financial system in 2008 wiped out more than $11 trillion in household wealth (Financial Crisis Inquiry Commission (FCIC) 2011: xv). Like forest fires, unanticipated crises can also be regenerative – revealing gaps in our thinking they can shake loose deeply held assumptions. This crisis was no different. Economists failed to recognize a looming catastrophe on the horizon and, once it had arrived, struggled to say anything useful about it (see Posner 2010: 305–32; Cooper 2008: 36). Political scientists writing on international economic relations did not do any better. A leading scholar of International Political Economy (IPE) calls the field's performance 'embarrassing' and 'dismal' (Cohen 2009: 437).

The financial crisis of 2008 reminds us that we live in a world of risk *and* uncertainty – a conceptual distinction that was developed by Knight and Keynes 90 years ago and which remains fundamentally important today (Keynes 1948[1921]; Knight 1921). In risky environments, sorting events into different classes poses no special challenge for sophisticated decision-makers. We cannot be sure what tomorrow will bring, but we can rest assured that unforeseen events will be drawn from known probability distributions 'with fixed mean and variance' (Meltzer 1982: 3).

In the world of risk the assumption that agents follow consistent, rational, instrumental decision rules is plausible. But that assumption becomes untenable when parameters are too unstable to quantify the prospects for events that may or may not happen in the future (Keynes 1937; Lawson 1985: 915–16). The past is not a prologue. Realms of uncertainty are subject to dramatic transformations in the underlying economic structure that permanently shift the mean of the distribution (Meltzer 1982: 17). In this new environment there is no basis for agents to settle on what the 'objective' probability distribution looks like. Experienced as 'turning points', crises elicit new narratives, signal the obsolescence of the status quo in markets and policy regimes, and inject deep uncertainty into agents' decision calculus (Widmaier *et al*. 2007). Thus market players and policy-makers must often rely on social conventions, such as alpha-numerical labels (AA, A-, and so on) that ratings agencies produce and market players use to estimate credit risk, that help stabilize

uncertain environments and guide future-oriented decision-making (Beckert 1996; 2002).

In this chapter we set out to illustrate how both economic and political actors cope in a world that is characterized by risk and uncertainty. To do so, we will first provide a brief conceptual clarification of risk and uncertainty, before turning to the role of conventions for minimizing future uncertainty. In contrast to large parts of the literature in International Political Economy and International Relations, we will argue that social conventions not only play an important – and underappreciated – role for dealing with uncertainty and for stabilizing uncertain environments, but that they are also invoked as part of a social performance to create and sustain the given order. We will substantiate our claims with illustrative evidence from domains both public (Central Banking) and private (Credit Rating Agencies).

Conventions as tools to minimize future uncertainty: rationalist and sociological optics

The financial crisis of 2008 was not an exogenous shock followed by a period of distributional struggles among rational actors eventually yielding a new equilibrium. The crisis illustrates instead the central importance of *social conventions* that actors adopt so that they can cope with uncertainty and that generate endogenously the seeds of systemic crisis.

The question of how uncertainty and convention shape behaviour is far from new (Steinbruner 1974; Kratochwil 1989; Wendt 2001: 1029–32). We follow the lead of economic sociologists and constructivist scholars of International Relations (IR) who view conventions as shared templates and understandings, 'often tacit but also conscious, that organize and coordinate actions in predictable ways', and which serve as 'agreed-upon, if flexible, guides for economic interpretation and interaction' (Biggart and Beamish 2003: 444). Conventions simplify uncertain situations by enabling agents to impose classification schemas on the world, thereby 'delineating the set of circumstances in which it [the convention] is applicable and can serve as a guide' (Kratochwil 1984: 688; see also Kratochwil 1989: 69–72). They are adopted by pragmatic, intentional agents seeking steadier footing in the presence of epistemic uncertainty.

Scholars disagree about the origins of enduring coordinative social conventions (Marmor 2009). Here, we emphasize conventions as shared social templates for managing epistemic uncertainty rather than as solutions to coordination dilemmas in strategic settings (Koslowski and Kratochwil 1994: 216). Yet, our analysis needs to encompass the toolkits both rationalist and sociological styles of analysis provide. The rationalist view that we live in a world of only calculable risk is too simple and leaves us with a dangerously incomplete view of economic life. We need to attend also to the social and cultural contexts in which rational actors encounter the ineluctable uncertainties that inhere in financial markets (Best and Paterson 2010), particularly when market conditions are unprecedented.

Rationalist optic

In recent decades many economists discarded the old idea that uncertainty formed a special case in which decision-making may not follow rational axioms. Prominently, *Subjective Expected Utility Theory* (SEUT) works backward from choices to infer probability estimates. Decision-makers may not have objective probabilities in a given choice setting, but in SEUT they behave as if they have a probability distribution in mind. The approach implies that 'we should formulate our beliefs in terms of a Bayesian prior and make decisions so as to maximize the expectation of a utility function relative to this prior' (Gilboa *et al*. 2009: 287).

Hirshleifer and Riley referred to Knight's distinction as 'a sterile one' (Hirshleifer and Riley 1992: 10). They were dismissive of critics who catalogued choices that deviated from SEUT's axioms: Such anomalies are akin to 'mental illusions' which are

> only a footnote to the analysis of valid inference […] when it comes to subtle matters and small differences, it is easy for people to fool themselves, or to be fooled. But less so when the issues are really important, for the economically sound reason that correct analysis is more profitable than error.
>
> (Hirshleifer and Riley 1992: 34, 39)

In the rationalist optic, inconsistency is costly. The insight suggests that agents operating in hypercompetitive financial markets should invest in information to try to avoid making systematic mistakes. As Blyth puts it, 'since being deluded all the time is very expensive, especially when making margin calls, one would expect agents operating in such markets to correct these mistakes' (Blyth 2003: 243). Over time, subjective probability estimates should converge on objective probabilities. Thus the idea of rational expectations was born (see Muth 1961; Lucas 1972; Sargent and Wallace 1976). SEUT says nothing about the utility function's content or the correctness of the probability estimates (Gilboa *et al*. 2008: 181). The rational expectations hypothesis goes a step further. It imposes 'equality between agents' subjective probabilities and the probabilities emerging from the economic model containing those agents' (Hansen and Sargent 2010: 4).

The rational expectations hypothesis had profound implications for the pricing of assets in financial markets. If market participants all share the same (correct) model of the economy and information is reasonably well distributed throughout the financial system, 'then agents' expectations about possible future states of the economy should converge and promote a stable and self-enforcing equilibrium' (Blyth 2003: 243). An investment community composed of rational individuals who share knowledge of the true underlying structure of the economy would not drive asset prices too far away (in either direction) from their fundamental value. As Leamer says, 'rationality of financial markets is a pretty straightforward consequence of the assumption that financial returns are

drawn from a "data generating process" whose properties are apparent to experienced investors and econometricians' (Leamer 2010: 38).

The effort to reduce the world to risk is not a story that is relevant only to economic theorists. Many IR and IPE specialists also embraced the dissolution of the analytical boundaries that delineated situations of risk from uncertainty. Often uncertainty was simply defined as risk. Consider, for example, how Koremenos conceptualizes 'uncertainty' in her work on the rational design of international agreements: 'parties always know the distribution of gains in the current period, but know only the probability distribution for the distributions of gains in future periods' (Koremenos 2005: 550). We observe abundant research in IR and IPE that either neglects or dismisses the conceptual distinction between risk and uncertainty (see Ahlquist 2006; Bernhard *et al*. 2002; Bernhard and Leblang 2006; Fearon 1998; Koremenos 2005; Koremenos *et al*. 2001; Mosley 2006; Rathbun 2007; Rosendorff and Milner 2001; see also Sobel 1999). In fact, the paradigmatic approach to the study of IPE – 'Open Economy Politics' (OEP), as coined by Lake – moves entirely in the world of risk and thus leaves the OEP approach largely unprepared to address issues of uncertainty in the world of finance (Lake 2009b, 2009a).

Sociological optic

That market actors and policy-makers behave as if they are maximizing utility with respect to subjective probability estimates – in other words, that they are rational agents living in the world of calculable risks – is by now a bedrock assumption in the social sciences. This is a big problem if, as we and others suggest (Abdelal *et al*. 2010; Beckert 1996, 2002, 2009; Best 2010; Blyth 2002, 2006; DiMaggio 2003; Woll 2008), the choice setting faced by decision-makers is more likely to be characterized also or solely by uncertainty.

However, a raft of experimental evidence documents anomalous behaviour that is completely inconsistent with subjective expected utility theory and that underlines the mistakes we are likely to make when we ignore uncertainty. The experimental research suggests that people are not axiomatically rational in the presence of uncertainty (Camerer and Weber 1992; Ellsberg 1961; Fox and Tversky 1995; Heath and Tversky 1991; Hogarth and Kunreuther 1995; Kahneman and Tversky 1984; Kunreuther *et al*. 1995; Zeckhauser 2010). Important decisions in and around financial markets are undertaken without precise knowledge about the probabilities of payoffs and the size of those payoffs. We simply do not know enough about the underlying process to reliably forecast future returns from past events.[2] Nonetheless, financial market actors still have to make choices – and they need to be confident that their decisions are the right ones; otherwise, they would be paralysed by indecision.

Constructivist and sociological approaches recognize that financial markets are complex, deeply interdependent patterns of economic and social activity. Market actors, and the policy-makers who observe and regulate financial markets, adopt social conventions to impose a sense of order and stability in

their worlds, thereby allowing 'exchange to take place according to expectations which define efficiency' (Storper and Salais 1997: 16). Conventions are not explicit agreements or formal institutions; rather, they are templates for understanding how to operate in contexts that are experienced as shared and common (Wagner 1994: 174) and they vary in their degree of materiality (Biggart and Beamish 2003: 452–3).

Economic sociologists argue that social conventions make it possible for markets to function with different degrees of efficiency. For example, securitization of mortgages (which we will discuss) hinges on practices of standardization. Creating liquid assets out of mortgage pools becomes possible when appraisers can define a neighbourhood from which to draw comparable sales data and when the credibility and independence of appraisers are deemed to be high enough for their judgements to be trusted. Both depend on social trust and accommodative public policies (Carruthers and Stinchcombe 1999: 360–6).

An important implication of the sociological optic is that models not only analyse markets but also alter them; they are not cameras, passively recording, but *engines* actively transforming such markets (MacKenzie 2006: 25). Representation and action are part of the same story. That story is not only about being right or wrong in our knowledge about the world but also about being able or unable to transform that world (MacKenzie *et al*. 2007: 2).[3] By incorporating financial economists' theoretical innovations into their practices, market participants brought their behaviour closer to those theories' predictions. In this way asset prices and other data points appeared to confirm the risk-based theories that emerged from financial economics.

The sociological optic counters the image of markets 'unaffected by ongoing social relations' in the rationalist, risk-based optic (Granovetter 1992: 6; see also Dobbin 2004: 2–5). It views financial markets as environments riddled with uncertainty and stabilized by conventions; and it suggests that intentional, pragmatic agents turn to social conventions to classify events, refine their own expectations about the future, and settle on a course of action. Sometimes agents consciously coordinate their behaviours in the interest of creating mutual expectations in risky situations. Often, however, they follow conventions to reduce epistemic uncertainty, recognizing that the prescriptive element of social conventions provides 'a basis for judging the appropriateness of acts by self and others' (Biggart and Beamish 2003: 444). Consequently we do not draw a bright line either between 'coordinating' and 'stabilizing' types of social conventions or between 'conventions' and 'norms'. Conventions are thus more or less deeply internalized by market participants (Marmor 2009). The conventions informing market expectations do not mirror underlying economic fundamentals; rather, the partial and distorted views that market participants impose on the world shape markets. And these views often evolve in a social environment where 'rumors, norms, and other features of social life are part of their understanding of finance' (Sinclair 2009: 451). In 'reflexive feedback loops' these views drive markets, which then subsequently shape beliefs and thus can generate far-from-equilibrium situations (Soros 2009).

Risk and uncertainty in Financial Market Governance: illustrative evidence from central banking and credit rating agencies

Taken together, the rationalist and sociological optics describe a world in which risk and uncertainty abound. We view financial markets erroneously if we impose on them the misplaced polarities of neoclassical economics and economic anthropology (Callon and Muniesa 2005). The following sections of the chapter illustrate the roles of uncertainty and conventions in domains both public (the Federal Open Market Committee's deliberations and communicative strategies) and private (credit rating practices). This will indicate how social conventions used to govern future uncertainty alter the very market order in which they take place.

Public actor: federal reserve policy-making between risk and uncertainty

Central banks are viewed almost exclusively through the lens of risk. At least since Kydland and Prescott's (1977) and Kenneth Rogoff's (1985) theoretical innovations delegation to independent central banks is treated as the route to price stability. In their decision-making process, central bankers are assumed to be able to calculate risks (Feldstein 2004). Situating central banks exclusively in this world misses a key fact, however: Central bankers understand that they are making decisions in the presence of risks *and* uncertainties. The best source of evidence on decision-making in the US Federal Reserve comes from transcripts of the Federal Open Market (FOMC) meetings. The transcripts from 2003 reveal the committee members' preoccupation with uncertainty in addition to risk.

> Chairman Greenspan: 'Most modelers are dealing with a controlled environment in which the number of variables is well short of a thousand. In the real world there are a million, and we don't know which ones are important. So it really matters. Therefore the base of information on which we act falls away, and risk aversion becomes a very predominant factor in the Committee's judgment of which way to move.'
>
> (FOMC 2003a: 37–8)

> Mr. Reinhart: 'The broader problem the Committee faces is whether it can usefully characterize the balance of risks in an environment of such diffuse uncertainty. This is territory that Frank Knight trod eighty-seven years ago. […] It may be that the current situation has transited from a sense of known possibilities with assigned probabilities – that is, risk – to Knightian uncertainty.'
>
> (FOMC 2003b: 71)

> Mr. Gramlich: 'I actually buy the Knightian uncertainty analogy and using that as a rationale for deferring the announcement of our judgment on the

> balance of risks. […] In my view we ought to have a call in a few weeks, and we ought to be thinking about acting even in the presence of continued Knightian uncertainty. The situation may not be convertible to nice probability distributions, but we may still have to act.'
>
> (FOMC 2003b: 79)

The FOMC transcripts also reveal committee members' attempts to communicate the degree of uncertainty in their deliberations to markets.

> Chairman Greenspan: 'I think the bottom line here is that it is important that we communicate the fact that this is truly a period in which uncertainty as distinct from risk is the dominant element in all of our deliberations.'
>
> (FOMC 2003b: 75)

> Mr. Guynn: 'I think it's absolutely critical that the minutes that are going to come out in three weeks are faithful to the tone of the discussion and reflect the range of uncertainty I heard around the table. And I heard an awful lot of uncertainty today, from people who were on the side of thinking that we need to pause to those who felt that we need to go faster in raising the funds rate. I also am growing uncomfortable with a statement released after the meeting that doesn't seem to describe that range of uncertainty and the latitude that we need as a Committee.'
>
> (FOMC 2005: 88)

> Mr. Plosser: 'I think that revealing a dispersion or the varying underlying policy assumptions that people are using going forward helps on the issue of uncertainty – that the world is uncertain and that our understanding of the way the macroeconomy works is uncertain. By revealing that some underlying sets of assumptions that we on the Committee are making to get to this set of objectives are different could actually be very helpful in reinforcing the view that the future is uncertain.'
>
> (FOMC 2007: 161)

As these quotations amply illustrate, the discussions of the FOMC are not, as rationalists argue, signals sent to show commitments to various strategies of uncertainty reduction either by different members to each other or by the committee as a whole to market actors. Rather, hoping to stabilize expectations these discussions seek to build common understandings under conditions of uncertainty.

In this endeavour central bankers exemplify the power of rhetoric that characterizes economics in general (McCloskey 1994). Central bankers use the theory of rational expectations in their discursive efforts to construct market actors' expectations. Through their authoritative position within the discourse central banks seek to create self-fulfilling policies, aided by a public that is attentive to the banks' discourse (Holmes 2009). Compelling narratives are important

resources for strategically influencing the expectations and practices of market participants. As Alan Blinder noted, 'perhaps the best a central bank can do is to "teach" the market its way of thinking' (Blinder 2004: 25).

From what we know of the operation of the FOMC during the last three decades, persuasive narratives are central to the effort of central banks to manage expectations in an unavoidably uncertain and risky world. Since the Federal Reserve works through markets, perceptions of market players are very important. The general pattern of accommodation of the Federal Reserve to the needs and views of the financial sector, evident in the Fed's continuing monitoring of the struggles of major firms, observed during the financial crisis after 2007 (Jacobs and King 2012: 8–9), is only one part of the story. The other is captured by Alan Blinder's description of markets as 'giant biofeedback machines' that monitor and publicly evaluate the policies of the Fed (Blinder 1998: 62).

During his long tenure Chairman Greenspan perfected the skill of 'talking to markets' (Greenspan 2003; Blinder and Reis 2005: 6–9). Stories stabilize expectations. Its experience, frank admission of complexity, seasoned judgement, and resolve in crisis all give the Federal Reserve an authority to rely on the stories it tells to generate faith in a future that is unknown and unknowable and which promises rewards and imposes risks that defy wholly or in part accurate calculation. Central banks do not send signals to reduce uncertainty. They attempt instead to shape what Beckert calls 'contingent expectations' (Beckert 2012: 18–19) that govern decisions made under conditions of uncertainty. Based on indeterminate interpretations these expectations are rooted in beliefs that are ultimately incalculable and that are driven as much by the future as the past. In sum, central banks exercise social power in and over the economy not simply by shaping price information from and in risky markets but by negotiating with markets over the interpretation of indeterminate situations under conditions of uncertainty (Hall 2008).

Private actor: rating agencies (illusorily) transforming uncertainty and risk

The rating industry – with Moody's, Standard & Poor's (S&P), and Fitch as the three largest firms – is indispensable for contemporary finance (Carruthers 2011; Hill 2004; Sinclair 2005). Its main purpose is to transform uncertainty into risk. During the financial crisis that started in 2007, rating companies proved to be spectacularly wrong in providing both clients and regulators with quantitative estimates of the credit-worthiness of various financial products (Silver 2012: 26–30, 45). These estimates were based on assumptions and simplifications, which in different forms had also been present in the spectacular collapse of Enron in 2001 and in the devastating Asian Financial Crisis of 1997. Despite these conspicuous failures the rating industry has been left largely unaffected by the intense political discussions and regulatory changes that followed in the wake of financial markets' convulsions in the fall of 2008. Deeply flawed as

their ratings have proved to be for clients and governments, it seems, these actors cannot do without the ratings the agencies provide. While criticisms of the performance of the rating agencies have been widespread, few have been able to come up with viable alternatives. The promise and allure of attempting to transform uncertainty into measurable risk remains very strong.

At their best, rating agencies provide information that enhances rational decision-making and makes markets more efficient. Starting in the middle of the nineteenth century firms began to offer the rating of the credit of counterparties first, later bonds and mortgages, and most recently of a wide spectrum of financial products that embody different kinds of risks. Take for example the mortgage industry boom leading up to the financial crisis that started in 2007 and doubled the profits of the three main rating agencies from $3 billion in 2002 to $6 billion in 2006. In fact Moody's profit margin was larger than that of any company in the S&P top 500 corporations for five years in a row (Partnoy 2006: 64–8). Unavoidably this process has always required simplification of information. In the case of corporate bonds the data showed that ratings predicted actual defaults reasonably well (MacKenzie 2011: 1811). But the financial crises which have rocked markets in the last two decades showed that the agencies failed badly in the rating of new financial instruments such as collateralized debt obligations (CDOs).[4]

While the technologies of simplification have changed enormously, the upshot was the same. Market uncertainties were 'domesticated' into manageable risks and thus were believed to have been 'conquered' (Carruthers 2011: 4; Hill 2010: 14). Since the 1980s financial innovation loosened the links between creditors and lenders. Illiquid debt and the associated risk no longer marked specific relationships but became disembodied and was captured in dizzying arrays of new products that were highly liquid, could be easily traded in markets and were difficult to understand. This change enhanced the importance, size, and profitability of rating agencies.[5] The spread of the securitization of risk in a broad range of new products made the information that rating agencies provide more important than ever before (Sinclair 2005). Since new products like CDOs were complex, investors were eager to have them rated so as to better assess their inherent degree of risk. Rating agencies applied the well-known labels to the new products with which they had classified corporate and government bonds for decades. In general, the mixing of different credit risks contained in the different tranches of credit risks pooled in new products resulted in substantially higher credit ratings than the underlying assets; more than half of the bundled sub-prime securities were rated AAA rather than just the 10–20 per cent of the total package that might have deserved such ratings (Willett 2012: 47).[6] Higher ratings made the new products more attractive to investors and more profitable to both investment banks and rating agencies. The greater complexity of the new products made them harder for investors and bankers (and raters) to understand and more profitable for rating agencies to rate (Carruthers 2010: 10).

Furthermore, some CDOs were pooled, tranched, and packaged together with credit default swaps, creating complex hybrid products (referred to as CDO^2s).

This led to a growing discrepancy between the risk that was being securitized and the quality of the underlying asset; furthermore, it created a multiplier effect for possible errors (Carruthers 2010: 13). One study reports that 70 per cent of the securitized assets in the sample studied were rated AAA while 93 per cent of the underlying assets had a credit rating of B or lower. The authors use the term 'alchemy' to describe the mismatch between the credit ratings of the securitized products and the credit quality of the underlying collateral. They speculate that the mismatch is driven by a boilerplate model that targeted 'the highest possible credit rating at the lowest cost, while catering to investor demands' (Benmelech and Dlugosz 2009: 3–4). This process further enhanced the profits and political clout of the financial sector and the rating agencies. Government deregulation at the international and domestic level was driven by the demand that the new securitization technology made government regulation largely unnecessary. The renegotiation of the Basle II agreement in 1996 transformed the conventional belief that risk analysis could be safely left to the models employed by the large banks and the ratings agencies into soft law governing the global financial system (Lockwood 2015). Chairman Greenspan was a powerful advocate of this convention. The social context of finance was international, bipartisan, and had hurdled the separation of powers. Thus lead was spun into gold (Porter 2010).

Conclusion: modelling finance in worlds of risk *and* uncertainty

Economic models do not only analyse financial markets. They alter them. Economic theory, as Miyazaki (2007) argues, not only stands outside of markets as an external object but often is intrinsic to market processes. In the form of self-validating feedback loops, the practical use of economic theory thus can make market processes more like their depiction in theory. In the words of Alan Blinder, 'Economists […] have bent reality (at least somewhat) to fit their models' (quoted in MacKenzie 2006: 25). And financial market actors bent models to fit reality.

Blinder's qualification – 'at least somewhat' – agrees with Michel Callon and Fabian Muniesa's view of markets as 'calculative collective devices' (Callon and Muniesa 2005: 1229–31). The characteristics of financial goods and services are often extremely uncertain and the number of actors involved in financial markets is often very large and highly dispersed. Callon thus asks, 'How can agents calculate when no stable information or shared prediction on the future exist?' (Callon 1998: 6). Markets are such effective institutions because they make possible complicated calculations that yield practical solutions that could not be reached by theoretical reflection only (Callon 1998: 23–32).

Callon and Muniesa's (2005) analysis sidesteps the one-sided views of neoclassical economics and anthropology. Economists take an abstract and formal view of markets, which, they assume, are governed by impersonal laws and populated by agents who are inherently calculative. Anthropologists prefer to dissolve the calculative competence of actors in rich ethnographies that view

quantitative practices as rationalizations for choices that are based on other logics. Neither view is very satisfying. The first overlooks the diversity of economic practices and forms of calculations that can be observed in markets; the second denies that economic forms of behaviour have any specificity whatever. The first thinks in terms of pure calculation; the second marginalizes all calculative practices. Both seem inappropriate for an analysis of the ambiguity that marks financial markets with their characteristic mixture of risk and uncertainty. Calculative behaviour includes but goes beyond mathematical or numerical calculations. It is a hybrid of calculation, judgement, and imagination. Avoiding positivist and constructivist preconceptions, economists can view the laws of the market as neither discoveries that reveal hidden truths, nor as constructions that illuminate an opaque reality. Economic laws account instead for 'regularities progressively enforced by the joint movement of the economy and economics'. Such regularities connect the obduracy of the real world with the contingency of the artefact of reason (Callon 1998: 46).

A financial crisis is therefore not only an event 'out there in reality' but also a set of interpretive and rhetorical acts 'in here', which can have different performative effects over time. The degree of congruence between 'out there' and 'in here' is a central stabilizing or destabilizing element of the financial order. Economists are part of a social performance by which their ideas are assimilated by experts and policy-makers who, against their better knowledge, pretend that they are true. Economic ideas are thus put into the service of making rather than merely representing reality. Furthermore, these ideas are built into the operation of both the financial system and the system of government regulation (Hjertaker 2012; Riles 2011). Jens Beckert (2010: 2, 7, 9, 25, 30) offers an explanation that is congruent with this work. Going beyond the collective identities, calculative tools, judgement devices, and cultural frames invoked by economic sociologists, he focuses on the central role of fictions for decisions made under conditions of uncertainty. A fictional or imagined future is not disclosed as such and regarded as separate from the real world. Instead it is perceived by relevant communities as a natural though contestable representation of the future that emerges in the process of social interaction. When calculation-based expectations under conditions of uncertainty are beyond reach, fictional rather than rational expectations are the foundation for noncapricious action. Imaginations of future uncertainty thus constitute and shape the present order.

Discursive politics shows that stability and instability in finance are not the outcome of autonomous market dynamics as much as they are deeply intertwined with those dynamics. For this reason, economic sociologists emphasize the relevance of social institutions and conventions in their analyses of markets (Dobbin 2004). We observe the centrality of social conventions in legal fictions sustaining neoliberal ideas as recently as the last few decades (Riles 2011), and as long ago as in the common commercial law for merchants that developed in Europe over several centuries prior to the emergence of domestic commercial regulations in nascent states (Swedberg 2004). Rationalist explanations of risk

are not only challenged but also complemented by the call heard from many different quarters: It is time to put the social back into the science with which we analyse financial markets.

Notes

1 This chapter adapts material from three papers we wrote on the topic of uncertainty and financial markets: 'Uncertainty, Risk, and the Financial Crisis of 2008', *International Organization* 68(2) (2014): 361–92; 'Reading the Right Signals and Reading the Signals Right: IPE and the Financial Crisis of 2008', *Review of International Political Economy* 20(5) (2013): 1101–31; and 'Worlds in Collision: Risk and Uncertainty in Hard Times', in M. Kahler and D. Lake (eds) *Politics in the New Hard Times: The Great Recession in Comparative Perspective*, Ithaca: Cornell University Press (2013), 233–52.

2 Leamer notes: 'if we cannot reliably assess predictive means, variances, and covariances' for things such as asset prices, 'then we are in a world of Knightian uncertainty in which expected utility maximization doesn't produce a decision' (Leamer 2010: 38–9; see also Blyth 2013; Mandelbrot and Taleb 2010).

3 Hall notes that what sociologists call performativity is essentially the same as 'what constructivists refer to as constitutive social processes' (Hall 2009: 456; see also De Goede 2005).

4 Securitization produced an array of products. Mortgage-backed securities were created from pools of loans purchased from originators. CDOs involved packaging tranches of the asset-backed securities (ABS) into new instruments that could be sold by the CDO manager to outside investors.

5 The number of analysts employed by Standard and Poor's, for example, increased 50-fold between 1986 and 2000 (from 40 to 2,000) (Rona-Tas and Hiss 2010: 125).

6 At an early date, in October 2008, the IMF estimated that of the total loss of $1.4 trillion more than half ($770 billion) was in mortgage-backed securities and the single largest category ($290 billion) was in asset-based CDOs (MacKenzie 2011: 1179).

References

Abdelal, R., Blyth, M. and Parsons, C. (2010) *Constructing the International Economy*, Ithaca, NY: Cornell University Press.

Ahlquist, J. S. (2006) 'Economic Policy, Institutions, and Capital Flows: Portfolio and Direct Investment Flows in Developing Countries', *International Studies Quarterly* 50: 681–704.

Beckert, J. (1996) 'What Is Sociological about Economic Sociology? Uncertainty and the Embeddedness of Economic Action', *Theory and Society* 25: 803–40.

Beckert, J. (2002) *Beyond the Market: The Social Foundations of Economic Efficiency*, Princeton, NJ: Princeton University Press.

Beckert, J. (2009) 'The Social Order of Markets', *Theory and Society* 38: 245–69.

Beckert, J. (2010) *Gold Will Rise to Two Thousand Dollars: Fictionality in Economic Action*, Unpublished manuscript, Köln: Max-Planck-Institut für Gesellschaftsforschung.

Beckert, J. (2012) *Capitalism as a System of Contingent Expectations: Toward a Sociological Microfoundation of Political Economy*, Discussion Paper 12(4), Köln: Max-Planck-Institut für Gesellschaftsforschung.

Benmelech, E. and Dlugosz, J. (2009) *The Alchemy of CDO Credit Ratings*, Working Paper 1487, Cambridge, MA: National Bureau of Economic Research.

Bernhard, W. and Leblang, D. (2006) *Democratic Processes and Financial Markets: Pricing Politics*, New York: Cambridge University Press.

Bernhard, W., Broz, J. L. and Clark, W. R. (2002) 'The Political Economy of Monetary Institutions', *International Organization* 56: 693–723.

Best, J. (2010) 'The Limits of Financial Risk Management: Or What We Didn't Learn from the Asian Crisis', *New Political Economy* 15: 29–49.

Best, J. and Paterson, M. (2010) 'Introduction: Understanding Cultural Political Economy', in J. Best, J. and M. Paterson (eds) *Cultural Political Economy.* New York: Routledge, 21–46.

Biggart, N. W. and Beamish, T. D. (2003) 'The Economic Sociology of Conventions: Habit, Custom, Practice, and Routine in Market Order', *Annual Review of Sociology* 29: 443–64.

Blinder, A. (1998) *Central Banking in Theory and Practice*, Cambridge, MA: MIT Press.

Blinder, A. (2004) *The Quiet Revolution: Central Banking Goes Modern*, New Haven, CT: Yale University Press.

Blinder, A. and Reis, R. (2005) 'Understanding the Greenspan Standard', in A. Greenspan (ed.) *The Greenspan Era: Lessons for the Future.* Jackson Hole, WY: Federal Reserve Bank of Kansas City.

Blyth, M. (2002) *Great Transformations: Economic Ideas and Institutional Change in the Twentieth Century*, New York: Cambridge University Press.

Blyth, M. (2003) 'The Political Power of Financial Ideas: Transparency, Risk, and Distribution in Global Finance', in J. Kirshner (ed.) *Monetary Orders: Ambiguous Economics, Ubiquitous Politics*, Ithaca, NY: Cornell University Press, 239–59.

Blyth, M. (2006) 'Great Punctuations: Prediction, Randomness, and the Evolution of Comparative Political Science', *American Political Science Review* 100: 493–8.

Blyth, M. (2013) 'This Time It Really Is Different: Europe, the Financial Crisis, and "Staying on Top" in the 21st Century', in D. Breznitz and J. Zysman (eds) *The Third Globalization: Can Wealthy Nations Stay Rich in The Twenty-First Century?* New York: Oxford University Press.

Callon, M. (1998) 'The Embeddedness of Economic Markets in Economics', in M. Callon (ed.) *The Laws of the Markets*, Oxford, UK: Blackwell, 1–57.

Callon, M. and Muniesa, F. (2005) 'Peripheral Vision: Economic Markets as Calculative Collective Devices', *Organization Studies* 26: 1229–50.

Camerer, C. and Weber, M. (1992) 'Recent Developments in Modeling Preferences: Uncertainty and Ambiguity', *Journal of Risk and Uncertainty* 5: 325–70.

Carruthers, B. G. (2010) *Knowledge and Liquidity: Institutional and Cognitive Foundations of the Subprime Crisis*, Unpublished paper, Chicago: Northwestern University, D. O. S.

Carruthers, B. G. (2011) *Turning Uncertainty into Risk: The Case of Credit Ratings*, Max-Planck Institute Conference Villa Vigoni, Köln: Max-Planck-Institut für Gesellschaftsforschung.

Carruthers, B. G. and Stinchcombe, A. L. (1999) 'The Social Structure of Liquidity: Flexibility, Markets, and States', *Theory and Society* 28: 353–82.

Cohen, B. J. (2009) 'A Grave Case of Myopia', *International Interactions* 35: 436–44.

Cooper, G. (2008) *The Origin of Financial Crises: Central Banks, Credit Bubbles and the Efficient Market Fallacy*, New York: Vintage Books.

De Goede, M. (2005) *Virtue, Fortune, and Faith: A Geneaology of Finance*, Minneapolis: University of Minnesota Press.

Dimaggio, P. (2003) 'Endogenizing "Animal Spirits": Toward a Sociology of Collective Response to Uncertainty and Risk', in M. F. Guilllen, R. Collins, P. England and M. Meyer (eds) *The New Economic Sociology: Developments in an Emerging Field*, New York: Russell Sage Foundation, 79–100.

Dobbin, F. (2004) 'The Sociological View of the Economy', in F. Dobbin (ed.) *The New Economic Sociology: A Reader*, Princeton, NJ: Princeton University Press.

Ellsberg, D. (1961) 'Risk, Ambiguity, and the Savage Axioms', *The Quarterly Journal of Economics* 75: 643–69.

FCIC (Financial Crisis Inquiry Commission) (2011) *The Financial Crisis Inquiry Report*, Washington, DC.

Fearon, J. D. (1998) 'Bargaining, Enforcement, and International Cooperation', *International Organization* 52: 269–305.

Feldstein, M. (2004) 'Innovations and Issues in Monetary Policy: Panel Discussion', *American Economic Review* 94(2): 41–8.

FOMC (Federal Open Market Committee) (2003a) Transcript of the Meeting of the Federal Open Market Committee on January 28–29.

FOMC (Federal Open Market Committee) (2003b) Transcript of the Meeting of the Federal Open Market Committee on March 18.

FOMC (Federal Open Market Committee) (2005) Transcript of the Meeting of the Federal Open Market Committee on May 3.

FOMC (Federal Open Market Committee) (2007) Transcript of the Meeting of the Federal Open Market Committee on June 27–28.

Fox, C. R. and Tversky, A. (1995) 'Ambiguity Aversion and Comparative Ignorance', *Quarterly Journal of Economics* 110: 585–603.

Gilboa, I., Postlewaite, A. and Schmeidler, D. (2008) 'Probability and Uncertainty in Economic Modeling', *Journal of Economic Perspectives* 22: 173–88.

Gilboa, I., Postlewaite, A. and Schmeidler, D. (2009) 'Is It Always Rational to Satisfy Savage's Axioms?', *Economics and Philosophy* 25: 285–96.

Granovetter, M. (1992) 'Economic Institutions as Social Constructions: A Framework for Analysis', *Acta Sociologica* 35: 3–11.

Greenspan, A. (2003) 'Monetary Policy under Uncertainty', *Federal Reserve Bank of Kansas City*, August 29. Online. Available at: www.federalreserve.gov/boarddocs/speeches/2003/20030829/default.htm (accessed 7 March 2019).

Hall, R. B. (2008) *Central Banking as Global Governance: Constructing Financial Credibility*, New York: Cambridge University Press.

Hall, R. B. (2009) 'Intersubjective Expectations and Performativity in Global Financial Governance', *International Political Sociology* 3: 453–7.

Hansen, L. P. and Sargent, T. (2010) *Wanting Robustness in Macroeconomics*, Unpublished manuscript, New York: New York University.

Heath, C. and Tversky, A. (1991) 'Preference and Belief: Ambiguity and Competence in Choice under Uncertainty', *Journal of Risk and Uncertainty* 4: 5–28.

Hill, C. A. (2004) 'Regulating the Rating Agencies', *Washington University Law Quarterly* 82: 43–94.

Hill, C. A. (2010) *Why Did Rating Agencies Do Such a Bad Job Rating Subprime Securities?*, Minnesota Legal Studies Research Paper 10–8, Minnesota: University of Minnesota Law School.

Hirshleifer, J. and Riley, J. G. (1992) *The Analytics of Uncertainty and Information*, New York: Cambridge University Press.

Hjertaker, I. (2012) *Regulating Risk: A Study of Basle II and the Copernican Turn to Financial Regulation*, Master thesis, Department of Political Science, University of Oslo.

Hogarth, R. M. and Kunreuther, H. (1995) 'Decision Making under Ignorance: Arguing with Yourself', *Journal of Risk and Uncertainty* 10: 15–36.

Holmes, D. R. (2009) 'Economy of Words', *Cultural Anthropology* 24: 381–419.

Jacobs, L. R. and King, D. (2012) *Concealed Advantage: The Federal Reserve's Financial Interventions after 2007*, Paper submitted for the conference 'Governing the Fed' at Oxford University.

Kahneman, D. and Tversky, A. (1984) 'Choices, Values and Frames', *American Psychologist* 39: 341–50.

Keynes, J. M. (1937) 'The General Theory of Employment', *Quarterly Journal of Economics* 51: 209–23.

Keynes, J. M. (1948[1921]) *A Treatise On Probability*, New York: Macmillan.

Knight, F. (1921) *Risk, Uncertainty, and Profit*, New York: Houghton Mifflin.

Koremenos, B. (2005) 'Contracting around International Uncertainty', *American Political Science Review* 99: 549–65.

Koremenos, B., Lipson, C. and Snidal, D. (2001) 'The Rational Design of International Institutions', *International Organization* 55: 761–99.

Koslowski, R. and Kratochwil, F. (1994) 'Understanding Change in International Politics: The Soviet Empire's Demise and the International System', *International Organization* 48: 215–47.

Kratochwil, F. (1984) 'The Force of Prescriptions', *International Organization* 38: 685–708.

Kratochwil, F. (1989) *Rules, Norms, and Decisions: On the Conditions of Practical and Legal Reasoning in International Relations and Domestic Affairs*, Cambridge: New York, Cambridge University Press.

Kunreuther, H., Meszaros, J., Hogarth, R. M. and Spranca, M. (1995) 'Ambiguity and Underwriter Decision Processes', *Journal of Economic Behavior and Organization* 26: 337–52.

Kydland, F. E. and Prescott, E. C. (1977) 'Rules rather than Discretion: The Inconsistency of Optimal Plans', *Journal of Political Economy* 85(3): 473–91.

Lake, D. A. (2009a) 'Open Economy Politics: A Critical Review'. *The Review of International Organizations* 4: 219–44.

Lake, D. A. (2009b) 'TRIPs across the Atlantic: Theory and Epistemology in IPE', *Review of International Political Economy* 16: 47–57.

Lawson, T. (1985) 'Uncertainty and Economic Analysis', *The Economic Journal* 95, 909–27.

Leamer, E. E. (2010) 'Tantalus on the Road to Asymptopia', *Journal of Economic Perspectives* 24: 31–46.

Lockwood, E. (2015) 'Predicting the Unpredictable: Value-At-Risk, Performativity, and the Politics of Financial Uncertainty', *Review of International Political Economy* 22: 719–56.

Lucas, R. E. (1972) 'Expectations and the Neutrality of Money', *Journal of Economic Theory* 4: 103–24.

Mackenzie, D. (2006) *An Engine, Not a Camera: How Financial Models Shape Markets*, Cambridge, MA: MIT Press.

Mackenzie, D. (2011) 'The Credit Crisis as A Problem in the Sociology of Knowledge', *American Journal of Sociology* 116: 1778–841.

Mackenzie, D. A., Muniesa, F. and Siu, L. (2007) 'Introduction', in D. A. Mackenzie, F. Muniesa, and L. Siu (eds) *Do Economists Make Markets? On The Performativity of Economics*, Princeton: Princeton University Press, 1–19.

Mandelbrot, B. and Taleb, N. N. (2010) 'Mild vs. Wild Randomness: Focusing on Those Risks That Matter', in F. X. Diebold, N. A. Doherty, and R. J. Herring (eds) *The Known, the Unknown, and the Unknowable in Financial Risk Management: Measurement and Theory Advancing Practice*, Princeton, NJ: Princeton University Press.

Marmor, A. (2009) *Social Conventions: From Language to Law*, Princeton, NJ: Princeton University Press.

McCloskey, D. N. (1994) *Knowledge and Persuasion in Economics*, New York: Cambridge University Press.

Meltzer, A. H. (1982) 'Rational Expectations, Risk, Uncertainty, and Market Reactions', in P. Wachtel (ed.) *Crises in the Economic and Financial Structure*, Lexington, MA: Lexington.

Miyazaki, H. (2007) 'Between Arbitrage and Speculation: An Economy of Belief and Doubt', *Economy and Society* 36: 396–415.

Mosley, L. (2006) 'Constraints, Opportunities, and Information: Financial Market-Government Relations around the World', in P. K. Bardhan, S. Bowles, and M. Wallerstein (eds) *Globalization and Egalitarian Redistribution*, Princeton, NJ: Princeton University Press, 87–119.

Muth, J. F. (1961) 'Rational Expectations and the Theory of Price Movements', *Econometrica* 29: 315–35.

Partnoy, F. (2006) 'How and Why Credit Rating Agencies Are Not like Other Gatekeepers', in Y. Fuchita and R. E. Litan (eds) *Financial Gatekeepers: Can They Protect Investors?*, Washington, DC: Brookings Institution Press, 59–100.

Porter, T. (2010) 'Risk Models and Transnational Governance in the Global Financial Crisis', in E. Helleiner, S. Pagliari, and H. Zimmermann (eds) *Global Finance in Crisis: The Politics of International Regulatory Change*, London: Routledge, 70–87.

Posner, R. A. (2010) *The Crisis of Capitalist Democracy*, Cambridge, MA: Harvard University Press.

Rathbun, B. C. (2007) 'Uncertain about Uncertainty: Understanding the Multiple Meanings of a Crucial Concept in International Relations Theory', *International Studies Quarterly* 51: 533–57.

Riles, A. (2011) *Collateral Knowledge: Legal Reasoning in the Global Financial Markets*, Chicago: University of Chicago Press.

Rogoff, K. (1985) 'The Optimal Degree of Commitment to an Intermediate Monetary Target', *Quarterly Journal of Economics* 100: 1169–89.

Rona-Tas, A. and Hiss, S. (2010) 'The Role of Ratings in the Subprime Mortgage Crisis: The Art of Corporate and the Science of Consumer Credit Rating', in M. Lounsbury and P. M. Hirsch (eds) *Markets on Trial: The Economic Sociology of the US Financial Crisis, Part A*, Bingley: Emerald Group Publishing, 115–55.

Rosendorff, B. P. and Milner, H. V. (2001) 'The Optimal Design of International Trade Institutions: Uncertainty and Escape', *International Organization* 55: 829–57.

Sargent, T. J. and Wallace, N. (1976) 'Rational Expectations and the Theory of Economic Policy', *Journal of Monetary Economics* 2: 169–83.

Silver, N. (2012) *The Signal and the Noise: Why So Many Predictions Fail – But Some Don't*, New York: Penguin Press.

Sinclair, T. J. (2005) *The New Masters of Capital: American Bond Rating Agencies and the Politics of Creditworthiness*, Ithaca, NY: Cornell University Press.

Sinclair, T. J. (2009) 'Let's Get It Right This Time! Why Regulation Will Not Solve or Prevent Global Financial Crises', *International Political Sociology* 3: 450–3.

Sobel, A. C. (1999). *State Institutions, Private Incentives, Global Capital*, Ann Arbor: University of Michigan Press.

Soros, G. (2009) General Theory of Reflexivity. *Financial Times*, 26 October. Online. Available: www.ft.com/content/0ca06172-bfe9-11de-aed2-00144feab49a (accessed 7 March 2019).

Steinbruner, J. D. (1974) *The Cybernetic Theory of Decision: New Dimensions of Political Analysis*, Princeton, NJ: Princeton University Press.

Storper, M. and Salais, R. (1997) *Worlds of Production: The Action Frameworks of the Economy*, Cambridge, MA: Harvard University Press.

Swedberg, R. (2004) 'On Legal Institutions and Their Role in the Economy', in F. Dobbin (ed.) *The Sociology of the Economy*, New York: Russell Sage Foundation.

Wagner, P. (1994) 'Dispute, Uncertainty and Institution in Recent French Debates', *Journal of Political Philosophy* 2: 270–89.

Wendt, A. (2001) 'Driving with the Rearview Mirror: On the Rational Science of Institutional Design', *International Organization* 55: 1019–49.

Widmaier, W. W., Blyth, M. and Seabrooke, L. (2007) 'Exogenous Shocks or Endogenous Constructions? The Meanings of Wars and Crises', *International Studies Quarterly* 51: 747–59.

Willett, T. D. (2012) 'The Role of Defective Mental Models in Generating the Global Financial Crisis', *Journal of Financial Economic Policy* 4: 41–57.

Woll, C. (2008) *Firm Interests: How Governments Shape Business Lobbying on Global Trade*, Ithaca, NY: Cornell University Press.

Zeckhauser, R. (2010) 'Investing in the Unknown and Unknowable', in F. X. Diebold, N. A. Doherty, and R. J. Herring (eds) *The Known, the Unknown, and the Unknowable in Financial Risk Management: Measurement and Theory Advancing Practice*, Princeton, NJ: Princeton University Press, 304–46.

10 Imagining future biothreats

The role of popular culture

Filippa Lentzos, Jean-Baptiste Gouyon and Brian Balmer

In thinking about the future, NATO claims to be taking a leaf out of Google co-founder Sergey Brin's book. Brin's approach to technology investment is that 'If what you're doing is not seen by some people as science fiction, it's probably not transformative enough' (Jha 2013). Following Brin's lead, Allied Command Transformation – the US-based strategic command at the head of NATO's military command structure – has turned to science fiction to help the organization advance its thinking about transformative technologies and future threats.

It commissioned a series of short stories from a group of futurist authors, asking them to explore and imagine how technology and trends could affect future operations. The authors were given a profile of the future developed from NATO's futures work, but were otherwise 'unbounded by military strictures or the subliminal requirement to be "realistic"' (Allied Command Transformation 2016: 9). The resulting anthology, *Visions of Warfare 2036*, was published in November 2016, with the aim 'to incite inventive thinking and discussion about future possibilities and to add to the toolbox that the Alliance military and others can leverage to imagine and contemplate how NATO will undertake operations in the coming decades' (Allied Command Transformation 2016: 9–10). In his introduction to the unprecedented anthology, the Director for NATO capability development at Allied Command Transformation, Lieutenant General Jeff Lofgren, writes:

> Many inventions and innovations were described in stories many years before they became a reality. Advanced submarines, flying to the moon, flip phones, iPads and the Internet itself were foretold decades before the underlying scientific challenges were solved. That futurist literature informs or inspires product design has become an established practice.
>
> (Allied Command Transformation 2016: 9)

In this chapter, we explore the wider and more informal role of futurist storytelling, or as NATO calls it 'futurist prototyping', in relation to biological weapons.

Biological weapons are, of course, prohibited. Their use in war was banned in 1925 under the *Protocol for the Prohibition of the Use in War of Asphyxiating,*

Poisonous or other Gases, and of Bacteriological Methods of Warfare (usually shortened to the Geneva Protocol); their development, production and stockpiling was banned under the 1972 *Biological Weapons Convention* (BWC). Yet concerns about these weapons have endured, and continue to escalate. A major source of growing concern about future biological weapons threats is military 'overmatch' ambitions (Lentzos 2018). In NATO countries, efforts to stay ahead of adversaries often rely heavily on investments in technological innovation and, today, a considerable part of that investment goes into the biological sciences. For instance, at DARPA (Defense Advanced Research Projects Agency), the US military's research wing – the goal to 'harness biology as technology' is one of four main areas of focus for its strategic investments.

Military investments in biology are coinciding with technical advances that have increasing potential for misuse (IAP 2015; Caves and Carus 2014). For instance, developments in microbiological, immunological and epidemiological research have been identified as potentially leading to the production of more 'useful' biological weapons: dangerous pathogens with increased virulence, altered host range, increased transmissibility, or greater resistance to therapeutic interventions (Lentzos 2017). Gene editing and engineering technologies have been identified as another area of concern, where developments could enable dangerous pathogens to be constructed from scratch in the lab, eradicated pathogens to be reconstituted, or entirely novel pathogens to be designed (Ben Ouagrham-Gormley and Vogel 2016; Koblentz 2017). Moving beyond pathogens, DNA origami, focused on folding DNA into nanoscale shapes, designed to perform specific mechanical functions or biological interactions, could potentially be used to programme nanorobots to release damaging payloads inside human bodies (Lentzos and Invernizzi 2018); and developments in neurobiological research could potentially be misused to alter people's emotions or memories, covertly implant ideas or cause cognitive shifts (Bruner and Lentzos, 2017).

Added to these technical advances is a convergence of contextual factors that could also contribute to lower barriers to biological weapons development and use (Lentzos 2017; Caves and Carus 2014). Geopolitically, an increasingly multipolar world is emerging, one in which rising powers view human rights, justice, transparency and the use of force differently. In this new environment, the treaties prohibiting biological weapons – the Geneva Protocol and the BWC – may be eroded. The nature of conflict and warfare is also rapidly evolving, and the character of military challenges confronting states is changing (Kaldor 2007, 2013). Under these conditions, with uncertainty, insecurity and complexity growing, some states may develop novel bioweapons for covert use in small-scale operations. States may even consider developing novel biological weapons for overt use against unprepared adversaries when they become involved in conflicts so serious that the advantages of using banned biological weapons are perceived to outweigh the political costs and military risks of resorting to proscribed weapons.

Efforts to characterize the threat of potential future biological weapons are politically more pertinent than ever. Yet, how can reliable predictions be made?

In this chapter, we discuss some of the difficulties inherent in making realistic assessments of the threat from future biological weapons, and we explore an element of these assessments that is understudied but significant: imagination and popular culture. We first describe the barriers and difficulties in making precise bioweapons threat assessments. We then make a theoretical case for why science fiction and anticipatory knowledge production are interlinked: Science fiction texts, and popular culture more broadly, are part of larger processes of knowledge diffusion and 'sense making'. Our cognitive concepts and the ordering frameworks we apply to the world are constituted and produced through the countless narratives and stories people invent and pass on.

Following Nexon and Neumann, we hold that art and popular culture should not only 'be treated as evidence about dominant norms, ideas, identities, or beliefs in a particular state, society or region' (Nexon and Neuman 2006: 13), but that culture can also co-constitute political actors, problems, values, representations and threat assessments. 'Art is the fountainhead from which political discourse, beliefs about politics, and consequent actions ultimately spring', Edelmann similarly writes.

> [It] should be recognized as a major and integral part of the transaction that engenders political behaviour. […] Works of art generate the ideas about leadership bravery, cowardice, altruism, dangers, authority, and fantasies about the future that people typically assume to be reflections of their own observations and reasoning.
>
> (Edelman 1995: 2–3)

As such, we use pop culture as a 'lens' that might provide insight into understanding how different groups 'see' biological weapons and how science fiction has a constitutive effect on biological threat assessments. We will illustrate our argument by introducing some of the most prominent examples from the bioweapons sci-fi genre. The chapter ends with an outlook on some of the key research questions that arise in this area.

Assessing future bioweapons threats

As barriers to biological weapons development and use decrease, identifying potential future biological weapons threats becomes more pressing. Yet, how, politically, do we start to conceive of these threats? What guides us in our thinking about the ways in which life science technology can be misused? What tools and information can reliably be drawn on? From where do we take our inspiration?

We know, of course, a great deal about natural outbreaks of disease; how they unfold, what their effects are, and how they impact communities more broadly. And we've had some experience of recent emerging disease outbreaks – SARS, H1N1, MERS, Ebola, Zika to name a few. But none of these are deliberate outbreaks. The historic record of deliberately introduced disease

outbreaks is very limited. There has only been a handful of incidents where amateurs, cults and other non-state actors have attempted to deliberately spread pathogens (Carus 2002), and there has been no documented state use of biological weapons – with the exception of secret, experimental use by Japan against civilians in rural Manchuria in China in the 1930s (Guillemin 2017) and covert attempts by Germany to use biological agents against livestock in World War I (Wheelis 1999).

There are examples of the sorts of biological weapons that were developed in some countries, such as pathogens on missiles, or in cluster bombs, spray tanks and aerosol generators, even pathogen-contaminated food (Lentzos 2016; Wheelis, Rózsa and Dando 2006). There is no comprehensive list, however, and the goals, motivations and ambitions behind the weapons are very different and often unclear, spanning the range from deterrence, intimidation, tactical military use, covert warfare, sabotage, to state-sponsored terrorism and assassination (Tucker 2000). There is not even a generally accepted list of past – or contemporary – states with biological weapons programmes from which to extrapolate into the future. Part of the problem with developing such a list is conceptual (Carus 2017). What does it mean to assert that a country has a biological weapons programme? As Seth Carus (2017: 130) has noted:

> Does a country have a program when it decides to acquire biological weapons? Or must it have some activity underway? If so, is a research activity sufficient evidence of a BW program, or must the country have progressed to the development of delivery systems? What would it mean to say that a country has a delivery capability?

Another major part of the problem is secrecy. Past biological warfare programmes were cloaked in extreme secrecy, concealed in laboratories at military sites often not listed on ordinary maps; with biological agents and projects designed to weaponize them assigned special code names and exceptionally high classification categories, and bioweaponeers sworn to secrecy and placed under constant surveillance. Likewise, any field testing of agents was undertaken with elaborate procedures for maintaining secrecy. While traces can be found in some official records, as well as through qualitative research, enabling parts of weapon programme histories to be pieced together (e.g. Gould 2005; Balmer 2001; Guillemin 1999), much of the documentation and other evidence of past programmes has been destroyed or remains classified.

Today, in stark contrast to nuclear weapons programmes, there are no countries that admit to having an offensive biological weapons programme. While government assessments of biological threats from sub-state actors – on the rise since the breakup of the Soviet Union in the early 1990s, and even more so following 9/11 and the anthrax attacks in the US a decade later (Wright 2007; Guillemin 2005; Vogel 2016) – are readily available, publicly available government assessments of biological weapon threats to national security from states are generally rare. The exception is the United States, whose State Department

annually reports on its compliance concerns with arms control, nonproliferation and disarmament treaties. The most recent report expressed concern that the Russian Federation has not 'satisfactorily documented whether [its inherited Soviet offensive] program was completely destroyed or diverted to peaceful purposes' but it is scant on additional details (US State Department 2018). Reports in previous years have expressed concerns about a number of other countries, peaking at 13 following 9/11 and the anthrax letters; these have been equally scant on detail. A small number of states (e.g. Israel) have not signed up to the BWC, while others (such as Syria and Egypt for example) have not ratified it.

Some conclude that 'open source information cannot unambiguously answer the question whether or not a state has offensive BCW [biological and chemical weapons] programmes' (Bucht *et al*. 2003: 97). Yet, there are challenges even for those privy to classified information (Vogel 2008, 2013; Nolan 2013). Vogel, for instance, demonstrates how the 'anticipatory frame' that CIA analysts used in their incorrect assessment of Iraq's biological weapons programme before the US invasion of Iraq in 2003 fixated the analysts on particular 'technical' pieces of information rather than integrating the more complex qualitative social, political and economic dynamics shaping Iraq's biological weapons development: 'factors which ultimately proved to be decisive' (Vogel 2008: 571). And it is not only in Iraq that the intelligence community got the biological weapons threat wrong. The size, scope and sophistication of the Soviet biological weapons programme took the US intelligence community completely by surprise when it began to be uncovered at the end of the Cold War, and the intelligence community also had to reevaluate assessments it made in the 1990s and early 2000s that Libya and Cuba had active BW programmes, retroactively concluding that its earlier judgements were incorrect (Carus 2017). As one senior official in the CIA's Counterproliferation Division reflected: 'We don't know more about the biological weapons threat than we did five years ago, and five years from now we will know even less' (Commission on the Intelligence Capabilities of the United States Regarding Weapons of Mass Destruction 2005).

Clearly, there are limited tools and data sets that can reliably be drawn on in evaluating future biological threats. This opens the assessment space to greater influence from other drivers and shapers. Some of these are direct and obvious, for instance, terrorism events like the World Trade Center and Oklahoma City bombings, the Aum Shinrikyo chemical attacks on the Tokyo underground, 9/11 and the subsequent anthrax letters; geopolitical events like the collapse of the Soviet Union, the revelations of defectors and informers, and the exposure of its Biopreparat biowarfare research organization; and particular scientific experiments, such as making mousepox more deadly, making bird flu transmissible between mammals, synthesizing poliovirus or horsepox from scratch, or reconstructing the extinct 1918 flu virus.

Other drivers and shapers are less 'trigger-like' and act more subtly: cumulative advances in different scientific fields; experiences of disease and pandemics like SARS, influenza, Ebola, MERS and Zika that provide clues as to what a

biological weapons attacks might be like or how to ascribe the cause to natural or deliberate factors (e.g. Martin *et al*. 2008); and strong personalities keeping the issues visible – scientists, weaponeers, politicians and security advisors alike.

There are also some drivers and shapers of biological threat assessments that have so far largely gone unrecognized in the scholarly and policy literature. We are interested in one of these, namely fictional imaginaries, which we suspect play a significant role in inspiring visions of future biological weapons. There are already a number of anecdotes circulating of science fiction affecting political conceptions. A good example comes from the Clinton administration in the 1990s. Investigative journalists with the *Times* and *The New York Times* have highlighted the role of fiction in supporting President Clinton think through future biological weapons threats. Amongst other things, they describe a meeting where J. Craig Venter, the pioneering synthetic biologist, discusses the misuse potential of synthetic biology with President Clinton. Venter had been part of the effort to map the smallpox virus and Clinton, they write, 'asked if smallpox could be spliced with another bug to make it more harmful. Venter replied that it could and that a new novel – *The Cobra Event* […] presented just such a scenario' (Miller *et al*. 2001: 224). Clinton apparently took a special interest in biological weapons, and he read widely on the topic:

> He devoured histories, newspaper and magazine articles, and especially fiction. Tom Clancy's *Rainbow Six*, a thriller about a counterterrorist team's efforts to prevent Armageddon, made a big impression. Another favourite was a Patricia Cornwell novel that focused on a female medical examiner's battle against a shadowy figure intent on using mutant smallpox for mass murder. But nothing caught the president's attention as much as *The Cobra Event*, the novel Venter had recommended and that Clinton read in early 1998. It depicted a mad scientist's determination to thin the world's population by infecting New York City with a designer pathogen. By combining smallpox, a virus similar to that of the common cold, and an insect virus that destroys nerves, the scientist invented an ideal doomsday germ – a 'brainpox' that spread quickly and melted the brain.
>
> (Miller *et al*. 2001: 224)

We are interested in understanding more systematically how science fiction impacts political thinking and the way in which it shapes how biological weapons are 'seen', not just by those at the very top, but by political stakeholders broadly understood, including civil servants, military officers, intelligence analysts, bioweapon expert, disarmament diplomats, activists and campaigners. In the following sections, we will first outline the theoretical case for examining how science fiction and anticipatory knowledge production are co-constituted and then provide a range of examples from the bioweapons genre to illustrate our claims.

Science fiction and anticipatory knowledge production

Lieutenant General Lofgren, the NATO Director for capability development, noted that futurist literature can inspire product design. This, of course, has been observed by a number of scholars too. Sheila Jasanoff, for instance, opens the introduction to her edited volume *Dreamscapes of Modernity* with the observation that 'Technological innovation often follows on the heels of science fiction, lagging authorial imagination by decades or longer' (Jasanoff 2015: 1). She highlights, among other examples, Mary Shelley's Frankenstein and the production of new life forms in biological labs nearly a century and a half later; Jules Verne's Nautilus heralding submarines before they became a reality many decades later; and Aldous Huxley's assembly-line of artificial human reproduction to serve state purposes dreamed up in the early 1930s and which is now starting to become a technical, if not moral, feasibility.

Science fiction stories can be meaning-making devices that bring certain worlds into existence whilst pretending only to describe them (White 1987; Curtis 1994). Looking at the specific case of movie portrayals of not yet existing technologies, what he calls 'diegetic prototypes', science communication scholar David Kirby remarks that cinematic representations of yet-to-be technologies 'can lead to real-world technological development' (Kirby 2010: 43). When these technologies are embedded within a narrative frame as part of the protagonists' everyday life, diegetic prototypes demonstrate to audiences these artefacts' necessity and viability. Because one social function of public expositions of science and technology is to create markets for innovations (Thorpe and Gregory 2010), by generating positive social expectations, diegetic prototypes can prompt corporate action and participate in turning fictional devices into actual artefacts. An example here is the gesture-based computer interface featured in Steven Spielberg's 2001 *Minority Report*. The film vernacularized a technology which has since become ubiquitous, notably as a key feature of smartphones. There are numerous such examples that can be pointed to, as testified by the consulting company, *SciFutures*, that NATO employed to create its *Visions of Warfare 2036* anthology and which also makes money out of creating customized sci-fi narratives for the likes of corporate giants Visa, Ford, Pepsi and Samsung (Romeo 2017).

Typically, however, science fiction writers distance themselves from straightforward cause–effect relations. For instance, Arthur C. Clarke, who created 'the scheming, lip-reading computer Hal thirty years before IBM programmers developed Deep Blue to beat chess master Gary Kasparov at his own game' (Jasanoff 2015: 1), has noted that:

> […] contrary to general belief – prediction is not the main purpose of science fiction writers; few, if any, have ever claimed 'this is how it will be.' Most of them are concerned with the play of ideas and the expiration of normal concepts in science and discovery. 'What if….?' is the thought underlying all writing in this field. What if man could become invisible?

> What if we could travel into the future? What if there is intelligent life elsewhere in the Universe? These are the initial grains around which the writer secretes his modest pearl. No one is more surprised than he is, if it turns out that he has indeed forecast the pattern of future.
>
> (Arthur C. Clarke (1977) cited in Erikson 2016: 194–5)

Science fiction stories are generally not meant to be predictions, estimates of future trends, nor blueprints for technological designs. They are explorative narratives about alternate, technologically inspired, worlds that are made up. Yet there are aspects of science fiction that ring true:

> [...] true in the sense of careful, thoughtful representations of what it might be like to live in the kind of world we might get in the future; true in the deeper sense of reflecting enduring realities of human existence, meaning, and identity; true in the sense of illustrating fundamental moral dilemmas faced by individuals and communities when confronted by new and emerging technologies, and the struggles to grapple meaningfully with those dilemmas in the only ways humans know how.
>
> (Miller and Bennett 2008: 600)

Science fiction thus has the potential, argue Miller and Bennett (2008), to be more than just story-telling; science fiction can present inquiries into the human dimensions of technological futures, they enable 'societies very different from our own to come alive' (Miller and Bennett 2008: 600). It is often the social aspects, not the technological ones, that drive futurist stories. As Jasanoff reflects about the interplay of social and material innovation in her *Dreamscapes of Modernity* introduction:

> Shelley's lab-generated monster turns murderous because he is excluded from society by his abnormal birth, and hence is denied the blessings of companionship and social life enjoyed by his creator. Jules Verne's Nemo, a dispossessed Indian prince driven by hatred of the British colonialists who exploited his land and destroyed his family, seeks freedom and scientific enlightenment in the ocean depths. Biopower runs amok in Aldous Huxley's imagined world, overwhelming human dignity and autonomy in the name of collective needs under authoritarian rule.
>
> (Jasanoff 2015: 1)

Bringing social thickness and complexity to considerations of technological developments has been a central aim of the field of science and technology studies (STS). Covering the history, philosophy and social studies of science, STS explores the co-constitutive processes between science and socio-political order, and has developed an interest in science fiction as a manifestation of science in popular culture. As a field of scholarship interested in understanding the relationship societies and cultures maintain with science

and technology, STS has tended to approach science fiction as an index of this relationship.

STS scholars assert that because literary creations are not created in a vacuum, the socio-technical imaginaries to be found in science fiction novels can be taken as commentaries, on their authors' part, on the state of science and technology at a given time and place (Sleigh, 2011).

> Science fiction offers a unique approach to thinking longer term about technology: one grounded in narratives that are people-centric, future-oriented, and focused on non-linear dynamics across the interaction of multiple technologies, value-laden images of future societies, questions of meaning and identity, and enduring symbols and problem framings.
>
> (Miller and Bennett 2008: 597)

As such, these texts are not only useful as sources for a kind of historical sociology of science, but also for mapping 'collectively held, institutionally stabilized, and publicly performed visions of desirable futures, animated by shared understandings of forms of social life and social order attainable through, and supportive of, advances in science and technology' (Jasanoff 2015: 4).

H. G. Wells' *The Island of Dr Moreau* (1896) provides a useful example. This short novel tells the story of the gruesome experiments that a scientist, exiled on a remote island and thus freed from the oversight of society, conducts on animals. The novel appeared in London shortly after the British Institute for Preventive Medicine was opened. In the early 1890s, this institute acted as a magnet for opponents to vivisection, at the time one of the most controversial techniques employed in medical research. *The Island of Dr Moreau* can be analysed as Wells reflecting on the cultural implications of this research method and on laboratory science more broadly. The novel, Martin Willis (2006) argues, presents readers with Wells' views on the potential dangers of leaving scientists' activity unchecked. The fictional account makes the case for the necessity of the social body to exert scrutiny on what is happening in laboratories at a time when they were rising as the core institution of professional science (Willis 2006).

The eponymous 1996 film adaptation of Wells' novel by John Frankenheimer can similarly be interpreted as an attempt to engage spectators in a reflection on the contemporaneous affordances of the life sciences. Frankenheimer's infamous adaptation features Marlon Brando, in one of his last appearances, as Dr Moreau. Just like his nineteenth-century counterpart, this Dr Moreau is concerned with perfecting the human race. Here again, it involves producing human-animal chimeras. But in the late twentieth century, genetic engineering has displaced vivisection as the main tool in the hand of the mad scientist. 'I have seen the devil, in my microscope. And I have changed him. … I have cut him into pieces. The devil … I found, is nothing more than a tiresome collection of genes', Brando-Moreau grandiosely intones in front of his dumbfounded antagonist Thewlis-Douglas.

Just as the 1890s were the decade of vivisection, so the 1990s were the decade of the gene. The year 1990 saw the American Department of Energy, the agency responsible for developing the US atomic bomb, pair with the American National Health Institute to launch the Human Genome Project. This endeavour to decrypt the entire complement of human DNA was met with expressions of worries and fear. For instance, an article in the British broadsheet the *Guardian* titled 'The Frankenstein Factor' warned of 'the sinister shadow of gene bending and social control' (Tyler and Kilmowski 1991). Another, later piece, explained transgenics as the 'manipulation and exchange of DNA', a science touching 'the core of our existence, able to blur the boundaries between animal, vegetal and mineral'. The article also warned that 'gene-pharms' applied transgenics to create 'hormonally mixed animals and plants chimeras which could appear on supermarket shelves' (Kohn 1994). The 1996 adaptation of *The Island of Dr Moreau*, with its gallery of monstrous chimeras – animals given human appearance through genetic manipulation – is thus a cautionary tale against the horrors of gene tinkering, of the kind the Human Genome Project helped make imaginable.

As these examples show, science fiction novels and films are virtual spaces where moral questions related to current scientific innovations can be debated. They are spaces for moral thought experiments (Gil 2018), questioning the potential consequences of pushing this or that innovation to the extreme. Science fiction can also prompt questions about scientists as well as science. Haynes, for example, has shown how the representation of scientists in film shifted over the twentieth century from the 'mad' scientist to the 'amoral' scientist (Haynes 1994). This resonates with historical accounts that show how twentieth-century scientists, such as Robert Oppenheimer, struggled with the tension between being, on the one hand, a scientist with an obligation to comment on the ethics of his research and, on the other, being a mere technician of the state with a moral responsibility to defer such judgements to wider society (Thorpe 2004). Fictional texts thus highlight that there is more to truth than factuality. Beliefs about science's truth-claims are decided also on moral grounds: Fictional texts ask whether discoveries, methods of investigation, or innovations are useful, meaningful and even desirable to our human existence (Sleigh 2011). Sociologists Mikael Hård and Andrew Jamison (2005: 161) write:

> Popular science fiction or, perhaps more correctly, technofiction movies are important barometers that often highlight contemporary problems and reflect current public concerns. They can be regarded as sensitizing instruments that play an important role in the process of cultural appropriation.

The argument of course extends to the study of world politics, as Nexon and Neumann (2006: 6) observe: 'If culture profoundly affects politics, then we cannot neglect popular culture, since it is within popular culture that morality is shaped, identities are produced and transformed, and effective analogies and narratives are constructed and altered.'

Science fiction in popular culture, like other instances of the public exposition of science, makes technology and science part of audiences' lived experience. This can, as mentioned, help create markets for prospective technologies. But novels and films can also be cautionary tales. They can function as interventions, by their authors, in the debates surrounding potential uses and applications of ongoing scientific and technological developments. For audiences, to consume these texts can be a means of participating in these debates (Miller and Bennet 2008).

Science fiction, then, is not just a 'window' or 'passive mirror' onto an already preexisting world. Representations 'play a crucial role in constituting the social and political world' (Nexon and Neumann 2006: 6). They are 'part of the processes of world politics themselves: they are implicated in producing and reproducing the phenomena that [some approaches] assume they merely reflect' (Weldes 2003: 12). Similarly, in terms of technological innovation, science fiction literature and cinema participate in the production of scientific knowledge, technological development and the social debates that go alongside it.

This participation means that the firm division between the worlds of fact and fiction – which makes it easy to dismiss popular culture in 'serious' debates about threat prediction or arms control – becomes problematic. In this vein, historian of science, Jon Turney, in his book *Frankenstein's Footsteps* argued that from Mary Shelley onwards, public debates about the ethics of emerging life sciences have been shaped as much by scientific developments as by images and events in science fiction (Turney 2000). In an analysis of press and parliamentary debate transcripts of debates over the desirability of embryo research, Michael Mulkay showed how both protagonists and antagonists in the debate drew on fictional images in articulating their case (Mulkay 1996). One might expect critics of embryo research to use negative images from science fiction to describe scientists, but Mulkay showed that scientists defending their work also drew on negative images (Frankenstein) to distance their work from the fictitious character.

More recently, Priscilla Wald's book, *Contagious*, argues that 'the repetition of particular characters, images and storylines' during real-world disease outbreaks (e.g. Patient Zero, super-spreaders, tenacious microbes at war, etc.) has real consequences for how we respond to those outbreaks (Wald 2008). She documents a gradual change in the language through which the media depicted viral contagion and the changing Cold War world that suggests a conceptual exchange between the rapidly developing field of virology and Cold War Politics. Wald is worth quoting at length:

> As viruses became increasingly sinister and wily, sneaking into cells and assuming control of their mechanisms, external agents, such as Communists, became viral, threatening to corrupt the dissemination of information as they infiltrated the nerve center of the state, the exchange crystallized value and often conflicting anxieties about the changes of the post-war world. The new affiliations that came with political realignments brought

> the need for new stories of group origins and the triumph of human values shaped in the crucible of possible devastation: the histories and mythologies that accompany profound social change. The insights of virology were central to those stories, as the vocabulary that permeated the newspapers and science journals of the period found extended expressions in the plot of novels and films. Those works dramatized the new scientific concepts and, like the media, they acted as a kind of reservoir host – to borrow a metaphor from science – in which scientific and political theories recombined, informing the mythology of the new age.
>
> (Wald 2008: 159)

Moreover, in their study on the Cold War press coverage of the BWC negotiating period, Balmer *et al*. (2016) point to another noteworthy aspect of the culture–science link: Since all biological weapons research programmes during the Cold War were cloaked in secrecy, 'fictional accounts of disease as a weapon of war formed a more accessible source of imagery and speculation about what constituted biological weapons' (Balmer *et al*. 2016: 80). In their subsequent analysis of a corpus of UK and US newspaper articles written about biological warfare during the BWC negotiating period (the newspapers spanned 1967–75), they identify two narratives, apparently contradictory, used by journalists writing about the nature of biological weapons. On the one hand, biological weapons were portrayed as morally offensive, yet highly effective and militarily attractive. Yet, interwoven with this discourse was a second register, which painted a picture of biological weapons as ineffective, unpredictable and of questionable value for the military.

In short, studies of the interaction of popular culture and science, like Turney's, Mukay's, Wald's and Balmer's, demonstrate a lively two-way communication between fiction and on-going real-world debates and events. In the remainder of this chapter, we will illustrate this interplay by introducing some of the most prominent examples from the bioweapons sci-fi genre.

Bioweapons sci-fi

While a niche interest, there is still a reasonable amount of science fiction dealing with biological weapons and the deliberate introduction of disease. An early fictional portrayal is Robert and Fanny Stevenson's *The Dynamiter* published in 1885, in which an anarchist narrator suggests the possibility of contaminating the sewage systems of British cities with typhoid bacteria. A contemporaneous work, along a very similar theme, is H. G. Wells' *The Stolen Bacillus*. The short story, published in 1894, describes the failed attempt of an anarchist to steal cholera bacteria to poison London's water supply and cause an epidemic. Commenting on the work, Costa and Baños note that Wells' story has contemporary resonance because it raises the issue of how murderous acts by some groups – 'anarchists in the past, radical Muslims in the present' – might hamper our attempts to comprehend their motivations and world-view

(Costa and Baños 2016). Other notable early works are Robert Potter's *The Germ Growers* (1892) in which alien invaders try to wipe out humans using biological warfare, Jack London's *Yah! Yah! Yah!* (1909) in which a punitive European expedition to a South Pacific island deliberately exposes the Polynesian population to the measles virus, and Jack London's *The Unparalleled Invasion* (1910) in which Western nations wipe out all of China with a biological attack.

There is continual interest in bioweapons themes by science fiction writers during the Cold War. At the start of the space race, as the US announced its intention to launch a satellite into orbit, Jack Finney's *The Body Snatchers*, published in 1955, imagined germs from space drifting to Earth and invading a California town, replacing sleeping people with perfect physical duplicates grown from plantlike pods while their human victims turn to dust. In John Wyndham's *The Day of the Triffids* (1951), government scientists arm orbiting satellites with virulent organisms. The germs in space theme reappears in Michael Crichton's popular novel *The Andromeda Strain*, published at the peak of the space race, in 1969, when the US landed the first humans on the Moon with Apollo 11. Crichton's novel features a military space mission to gather pathogens for biological warfare. Mysterious microbes are then brought back to Earth on a space probe spurring a deadly outbreak that threatens human extinction. Similar apocalyptic themes comprise a number of novels, such as D. G. Compton's *Quality of Mercy* (1965), which portrays biological weapons as a means to combat overpopulation, and James Tiptree Jr's *The Last Flight of Dr. Ain* (1969), featuring a scientist travelling the world and releasing a virus targeted to eliminate humanity before it can destroy all life on Earth via climate change. In Frank Herbert's *The White Plague* (1982), a vengeful molecular biologist creates an artificial plague that is carried by men but only kills women. The scientist releases the disease in select countries, then holds the governments of the world hostage to his demands lest he release more plagues. Crossing into the horror genre, James Tiptree Jr's *The Screwfly Solution* (1977) imagines a disease that turns the human sex drive into a drive to kill, and Stephen King's *The Stand* (1978) narrates the accidental release of a weaponized strain of influenza from a remote US army base.

The post-Cold War period, with its rise of bioterrorism and rogue nations, as well as advances in genetic modification techniques, saw a string of novels featuring deliberate disease introductions, often through genetically engineered viruses. Perhaps best-known is Richard Preston's *The Cobra Event* (1998) – the novel that had grabbed Clinton's attention – with its 'Cobra' chimera of smallpox and flu virus forming the basis of a bioterrorism attack. Tom Clancy's *Rainbow Six* (1998), another Clinton favourite, featured an elite multinational counter-terrorist unit, 'Rainbow', which foils a radical eco-terrorist plan to carry out a sophisticated bioweapon attack with a mutated form of Ebola to infect Olympic athletes and spectators, and eventually wipe out the human race. *Executive Orders* (1996), an earlier Clancy novel, portrays an attempt by Iran to use a strain of airborne Ebola virus to infect and devastate the US population. In

other scenarios, Robin Cook's *Contagion* (1995) presented a mysterious deadly outbreak at a New York hospital which turns out to be spread by sabotage; Cook's later novel *Vector* (1999) saw a bioterrorist attack in the US using anthrax spores and botulinum toxin, and Chuck Hogan's *The Blood Artists* (1998) saw a deadly virus first appearing in the Congo resurface two years later in the US.

Films have also proved a popular medium for fictional portrayals of biological weapons. The novels, *Invasion of the Body Snatchers* and *The Andromeda Strain*, were both made into movies. John Sturges' 1965 film *The Satan Bug* portrayed a madman stealing a recently developed virus (the 'Satan Bug') from a secret bioweapons lab in the California desert which could wipe out the Earth's population in months. In the James Bond spy film *On Her Majesty's Secret Service* (1969), women were brainwashed by the villain to disseminate biological warfare agents throughout the world. Boris Sagal's *The Omega Man* (1971) saw biological warfare between China and Russia kill most of the world's population.

Two blockbusters in the 1990s stand out. Terry Gilliam's *Twelve Monkeys* (1995) presented a deadly virus that wipes out almost all of humanity, forcing remaining survivors to live underground. A mysterious terrorist group, known as the Army of the Twelve Monkeys, is believed to be behind the virus, but it turns out to have been released by a disgruntled scientist. In Wolfgang Peterson's *Outbreak* (1995), a highly infectious, deadly virus is transported to the US via an African monkey host and people start dying. The US Army Medical Research Institute for Infections Diseases and the CDC, headed by an ex-husband and his former wife, rush to stop its deadly spread.

The 2000s saw *Mission Impossible 2* (2000) in which a secret agent is sent to Sydney to find and destroy a genetically modified disease called 'Chimera' before a gang of international terrorists, who have already managed to steal the cure, get to it and can complete their grand plan of infecting the whole world. Danny Boyle's *28 Days Later* (2002) narrates how a deadly, modified 'rage' virus is accidentally released and leads to a breakdown of society. Steven Soderbergh's *Contagion* (2011), coming in the wake of the SARS and H1N1 outbreaks, presents a natural virus outbreak, spread from bats via pigs to humans and which affects victims' brain and central nervous system. Matthew Vaughn's *Kingsman: The Secret Service* (2014) turned its focus away from disease-causing to behaviour-inducing weapons, with its deliberately released neurochemical signal, transmitted via SIM cards, which causes people to become murderously violent, 'culling' the human race to avert its extinction.

More recently, biological weapons have been portrayed in a number of television series, e.g. Jason Rothenberg's *The 100* (2014), Michael Bay's *The Last Ship* (2014), Ronald D. Moore's *Helix* (2014), Michael McGowan's *Between* (2015), Steven Spielberg's *Falling Skies* (2015) and Julie Plec's *Containment* (2016). Video games, too, have proved a popular medium for imagining deliberate diseases scenarios and bring a uniquely immersive and 'lived' first-person experience, e.g. *Command and Conquer: General* (2003), *Acts of War: Direct*

Action (2005), *Dead Island* (2011), *Crysis 2* (2011), *Plague Inc.* (2012), *Call of Duty: Advanced Warfare* (2014), *Batman: Arkham Knight* (2015), and *The Division* (2016).

While by no means complete, this brief review of fictional depictions of biological weapons have highlighted some of the rich material available for analysis. In the concluding section, we outline some of the key research questions we believe important for future work in this field.

Conclusion

This chapter has outlined some of the difficulties and uncertainties in assessing the future threat from biological warfare. In this context, it remains important to think about the more immediate drivers and shapers of the threat, such as new developments in science, the changing nature of conflict and the emergence of new sub-state actors. We have argued, however, that we should also pay attention to less tangible ways in which our perception of the threat is shaped and articulated. In particular, we have little to no understanding of how popular culture provides tools and resources for considering the threat.

Various approaches can be taken to systematically explore the impact of science fiction on political thinking and the way in which it shapes how biological weapons are 'seen'. From our perspective, some of the key research questions for future work in this area are:

- What are the biological threats 'brought into existence' through popular culture? How are these portrayed? How do they relate to the contemporaneous social, political and technical contexts? Is there a dominance of Western fictional imaginaries? What is at stake in these portrayals?
- How are scenarios, characters, technologies, metaphors, images and vocabularies from science fiction brought into technical, political and public discourses? How do fictional accounts provide points of reference for intelligence officers, military officers, biosecurity experts, doctors, epidemiologists, politicians, civil servants, disarmament diplomats, campaigners and pressure groups (e.g. Carpenter 2016; Young and Carpenter 2018), activist scientists and the wider public? How do they shape the threats stakeholders see and prepare for? What are the conceptual exchanges?
- In what ways does popular culture provide a space for moral debate around advancing biological science and possibilities for militarization? How is the ethics of biological weapons development and use represented? How do these representations unite members of a social community in shared perceptions of futures that should or should not be realized? How are these representations drawn on, or opposed, in political contexts?
- To what extent do fictional imaginings follow, mirror or drive technical, political and public debates around future biological threats? How might they create markets of innovation for prospective technologies?

There are further directions to be considered. Most, though not all, academic studies of science fiction dwell on Western cultures; and they tend to shy away from empirical studies of how audiences actually consume and make use of popular culture.

Biological weapons are a pervasive yet difficult threat to address; they may have their roots in scientific developments but they are also significant cultural products. Delving into the rich complexity of the cultural spaces in which these weapons are conceived enables fictional portrayals to be deliberately, rather than unconsciously and uncritically, taken into account. A greater understanding of anticipatory knowledge production may also help generate novel ideas about their control and elimination, as well as enable a greater possibility of shaping the 'looping effects' (Hacking 2001) of envisioned futures.

References

Allied Command Transformation (2016) *Vision of Warfare: 2036*, Norfolk, VA: Allied Command Transformations.

Balmer, B. (2001) *Britain and Biological Warfare: Expert Advice and Science Policy, 1930–65*, Basingstoke: Palgrave.

Balmer, B., McLeish, C. and Spelling, A. (2016) 'Preventing "A Virological Hiroshima": Cold War Press Coverage of Biological Disarmament', *Journal of War and Culture Studies* 9(1): 74–90.

Ben Ouagrham-Gormley, S. and Vogel, K. M. (2016) 'Gene Drives: The Good, the Bad, and the Hype', *The Bulletin of Atomic Scientists*, 14 October. Online. Available: https://thebulletin.org/2016/10/gene-drives-the-good-the-bad-and-the-hype (accessed 14 October 2016).

Bruner, R. and Lentzos, F. (2017) 'Neuroscience – and the New Weapons of the Mind', *The Bulletin of Atomic Scientists*, 27 October. Online. Available: https://thebulletin.org/2017/10/neuroscience-and-the-new-weapons-of-the-mind (accessed 27 October 2017).

Bucht, G., Hart, J., Hjalmarsson, K., Lindblad, A., Roffey, R., Sundqvist, R., Trogen, L., Zanders, J. P. and Westerdahl, K. S. (2003) *Iran's Disarmament and Arms Control Policies for Biological and Chemical Weapons, and Biological Capabilities*, Umeå, SE: Swedish Defence Research Agency.

Carpenter, C. (2016) 'Rethinking the Political/-Science-/Fiction Nexus: Global Policy Making and the Campaign to Stop Killer Robots', *Perspectives on Politics* 14(1): 53–69.

Carus, W. S. (2002) *Bioterrorism and Biocrimes: The Illicit Use of Biological Agents since 1900*, Amsterdam, NL: Fredonia Books.

Carus, W. S. (2017) 'A Century of Biological-Weapons Programs (1915–2015): Reviewing the Evidence', *Nonproliferation Review* 24(1–2): 129–53.

Caves Jr., J. P. and Carus, W. S. (2014) *The Future of Weapons of Mass Destruction: Their Nature and Role in 2030*, Occasional Paper 10, Washington, DC: National Defense University Press.

Commission on the Intelligence Capabilities of the United States Regarding Weapons of Mass Destruction (2005) *Report to the President of the United States*.

Corcos, C (2003) 'Biological Warfare and Law in Film and TV: Some Thoughts on the Links between Real Life and Reel Life', *Picturing Justice: The Online Journal of Law and Popular Culture.* Online. Available: http://usf.usfca.edu/pj/biowarfare_corcos.htm

(accessed 8 July 2014). (The journal ceased publishing in 2006 and an attempt to find the article online on 28 February 2018 failed.)

Costa, H. and Baños, J. (2016) 'Bioterrorism in the Literature of the Nineteenth Century: The Case of Wells and the Stolen Bacillus', *Cogent Arts and Humanities* 3(1): 1224538.

Curtis, R. (1994) 'Narrative Form and Normative Force: Baconian Story-Telling in Popular Science', *Social Studies of Science* 24(3): 419–61.

Davies, S. R. and Horst, M. (2016) *Science Communication: Culture, Identity and Citizenship*, Basingstoke: Palgrave Macmillan.

Edelman, M. (1995) *From Art to Politics: How Artistic Creations Shape Political Conceptions*, Chicago: University of Chicago Press.

Erikson, M. (2016) *Science, Culture and Society*, Cambridge: Polity.

Gil, S. (2018) 'It's Alive in the Laboratory of the Mind: Frankenstein, Thought Experiment and Facing the Future of Science', *Journal of Science and Popular Culture* 1(1): 27–41.

Gould, C. (2005) *South Africa's Chemical and Biological Warfare Program 1981–1995*, Doctorate thesis in fulfilment of a doctorate of History, Rhodes University.

Gregory, J. and Miller, S. (2000) *Science in Public: Communication, Culture, and Credibility*, London: Perseus Publishing.

Guillemin, J. (1999) *Anthrax: The Investigation of a Deadly Outbreak*, California: University of California Press.

Guillemin, J. (2005) *Biological Weapons: From the Invention of State Sponsored Programs to Contemporary Bioterrorism*, New York: Columbia University Press.

Guillemin, J. (2017) *Hidden Atrocities: Japanese Germ Warfare and American Obstruction of Justice at the Tokyo Trial*, New York: Columbia University Press.

Hacking, I. (2001) *The Social Construction of What?*, Cambridge, MA: Harvard University Press.

Hård, M. and Jamison, A. (2005) *Hubris and Hybrids: A Cultural History of Technology and Science*, London: Routledge.

Haynes, R. D. (1994) *From Faust to Strangelove: Representations of the Scientist in Western Literature*, Baltimore: Johns Hopkins University Press.

InterAcademy Partnership (IAP) (2015) *The Biological and Toxin Weapons Convention: Implications of Advances in Science and Technology*, Conference Report.

Jasanoff, S. (2015) 'Future Imperfect: Science, Technology, and the Imaginations of Modernity', in S. Jasanoff and S.-H. Kim (eds) *Dreamscapes of Modernity: Sociotechnical Imaginaries and the Fabrication of Power*, Chicago: University of Chicago Press, 1–33.

Jha, A. (2013) 'Google's Sergey Brin Bankrolled World's First Synthetic Beef Hamburger', *Guardian*, 5 August. Online. Available: www.theguardian.com/science/2013/aug/05/google-sergey-brin-synthetic-beef-hamburger (accessed 5 March 2019).

Kaldor, M. (2007) *New and Old Wars*, Stanford, CA: Stanford University Press.

Kaldor, M. (2013) 'In Defence of New Wars', *Stability: International Journal of Security and Development* 2(1): 1–16.

King, J. and Strauss, H. (1990) 'The Hazards of Defensive Biological Warfare Programs', in S. Wright (eds) *Preventing a Biological Arms Race*, Cambridge, MA: The MIT Press, 120–32.

Kirby, D. (2010) 'The Future Is Now: Diegetic Prototypes and the Role of Popular Films in Generating Real-World Technological Development', *Social Studies of Science* 40(1): 41–70.

Koblentz, G. D. (2017) 'The De Novo Synthesis of Horsepox Virus: Implications for Biosecurity and Recommendations for Preventing the Reemergence of Smallpox', *Journal of Health Security* 15(6): 620–8.

Kohn, M. (1994) 'Stretched Genes', *The Observer*, 6 March 1994: 4.

Kupferschmidt, K. (2017) 'How Canadian Researchers Reconstituted an Extinct Poxvirus for $100,000 Using Mail-Order DNA', *Science*, 6 July. Online. Available: www.sciencemag.org/news/2017/07/how-canadian-researchers-reconstituted-extinct-poxvirus-100000-using-mail-order-dna (accessed 5 March 2019).

Kupferschmidt, K. (2018) 'A Paper Showing How to Make a Smallpox Cousin Just Got Published: Critics Wonder Why', *Science*, 19 January. Online. Available: www.sciencemag.org/news/2018/01/paper-showing-how-make-smallpox-cousin-just-got-published-critics-wonder-why (accessed 5 March 2019).

Lentzos, F. (2016) *Biological Threats in the 21st Century: The Politics, People, Science and Historical Roots*, London: Imperial College Press.

Lentzos, F. (2017) 'Ignore Bill Gates: Where Bioweapons Focus Really Belongs' *The Bulletin of Atomic Scientists*, 3 July. Online. Available: https://thebulletin.org/2017/07/ignore-bill-gates-where-bioweapons-focus-really-belongs (accessed 5 March 2019).

Lentzos, F. (2018) 'How Do We Control Dangerous Biological Research?' *The Bulletin of Atomic Scientists*, 12 April. Online. Available: https://thebulletin.org/2018/04/how-do-we-control-dangerous-biological-research (accessed 5 March 2019).

Lentzos, F. and Invernizzi, C. (2018) 'DNA Origami: Unfolding Risk?' *The Bulletin of Atomic Scientists*, 25 January. Online. Available: https://thebulletin.org/2018/01/dna-origami-unfolding-risk (accessed 5 March 2019).

Martin, S., Clunan, A. L. and Lavoy, P. (2008) *Terrorism, War or Disease? Unravelling the Use of Biological Weapons*, Palo Alto, CA: Stanford University Press.

Miller, C. A. and Bennett, I. (2008) 'Thinking Longer Term About Technology: Is there Value in Science Fiction-Inspired Approaches to Constructing Futures?' *Science and Public Policy* 35(8): 597–606.

Miller, J., Engelberg, S. and Broad, W. (2001) *Germs: The Ultimate Weapon*, London: Simon & Schuster.

Mulkay, M. (1996) 'Frankenstein and the Debate over Embryo Research', *Social Studies of Science* 21(2): 157–76.

Nexon, D. H. and Neumann, I. B. (2006) 'Introduction: Harry Potter and the Study of World Politics', in D. H. Nexon and I. B. Neumann (eds) *Harry Potter and International Relations*, Lanham, MD: Rowman & Littlefield, 1–23.

Nolan, B. R. (2013) 'Information Sharing and Collaboration in the United States Intelligence Community: An Ethnographic Study of the National Counterterrorism Center', Doctorate thesis in fulfilment of a doctorate in Sociology, University of Pennsylvania.

Noyce, R. S., Lederman, S. and Evans, D. H. (2018) 'Construction of an Infectious Horsepox Virus Vaccine from Chemically Synthesized DNA Fragments', *PloS ONE* 13(1): e0188453.

Rappert, B. and Gould, C. (2017) *Dis-Eases of Secrecy: Tracing History, Memory and Justice*, Johannesburg: Jacana Media.

Romeo, N. (2017) 'Better Business through Sci-fi', *The New Yorker*, 30 July. Online. Available: www.newyorker.com/tech/annals-of-technology/better-business-through-sci-fi (accessed 5 March 2019).

Sleigh, C. L. (2011) *Literature and Science*, Basingstoke: Palgrave Macmillan.

Thorpe, C. (2004) 'Violence and the Scientific Vocation', *Theory, Culture and Society* 21(3): 59–84.

Thorpe, C. and Gregory, J. (2010) 'Producing the Post-Fordist Public: The Political Economy of Public Engagement with Science', *Science as Culture* 19(3): 273–301.

Tucker, J. (2000) 'Motivations for and against Proliferation: The Case of the Middle East', in R. A. Zilinskas (ed.) *Biological Warfare: Modern Offense and Defense*, Colorado and London: Lynne Rienner, 27–52.

Turney, J. (2000) *Frankenstein's Footsteps*, New Haven: Yale University Press.

Tyler, A. and Kilmowski, A. (1991), 'The Frankenstein Factor', *Guardian*, 16 March 1991: 8.

United Kingdom of Great Britain (2013) 'We Need to Talk about Compliance: A Response to BWC/MSP/2012/WP.11'. Online. Available: www.unog.ch/80256EDD006B8954/(httpAssets)/B6A0C5EB28982274C1257B9B00553CE9/$file/UK+Compliance+WP.pdf (accessed 5 March 2019).

US State Department (2018) *2018 Report on Adherence to and Compliance with Arms Control, Non-Proliferation, and Disarmament Agreements and Commitments*, Washington, DC: Arms Control, Verification and Compliance Bureau (AVC).

Vogel, K. M. (2008) '"Iraqi Winniebagos™ of Death": Imagined And Realized Futures of US Bioweapons Threat Assessments', *Science and Public Policy* 35(8): 561–73.

Vogel, K. M. (2013) *Phantom Menace or Looming Danger? A New Framework for Assessing Bioweapons Threats*, Baltimore, MA: Johns Hopkins University Press.

Vogel, K. M. (2016) 'Aftershocks of the 2001 Anthrax Attacks', in F. Lentzos (eds) *Biological Threats in the 21st Century: The Politics, People, Science and Historical Roots*, London: Imperial College Press, 211–37.

Wald, P. (2008) *Contagious*, Durham: Duke University Press.

Weldes, J. (2003) 'Popular Culture, Science Fiction and World Politics', in J. Weldes (eds) *To Seek out New Worlds: Science Fiction and World Politics*, London: Palgrave, 1–27.

Wheelis, M. (1999) 'Biological Sabotage in World War I' in E. Geissler and J. E. van Courtland Moon (eds) *Biological and Toxin Weapons: Research, Development and Use from the Middle Ages to 1945*, Oxford: Oxford University Press, 35–62.

Wheelis, M., Rózsa, L. and Dando, M. (2006) *Deadly Cultures: Biological Weapons since 1945*, Cambridge and London: Harvard University Press.

White, H. (1987) *The Content of the Form: Narrative Discourse and Historical Representation*, Baltimore: Johns Hopkins University Press.

Willis, M. (2006) *Mesmerists, Monsters, and Machines*, Kent, OH: The Kent State University Press.

Wright, S. (2007) 'Terrorists and Biological Weapons: Forging the Linkage in the Clinton Administration', *Politics and the Life Sciences* 25(1–2): 57–115.

Young, K. L. and Carpenter, C. (2018) 'Does Science Fiction Affect Political Fact? Yes and No: A Survey Experiment on "Killer Robots"', *International Studies Quarterly* 62(3): 562–76.

11 Forecasting civil war and political violence

Corinne Bara

As this book goes to press, the world is witnessing one of the deadliest civil wars in recent decades. Now in its eighth year, the war in Syria has killed more than half a million people (Al Jazeera 2018), and unspeakable atrocities have been committed, including against children. While this war is unusually complex and protracted, the processes that have led to this quagmire are not unique. In fact, findings from the academic study of past conflicts can shed light on many puzzles of the Syrian war, such as why it escalated from peaceful protest, why it has been lasting so long, why it is so extremely violent, and why so hard to stop.[1] Understanding conflicts that have already happened or are ongoing, however, has never been the only or primary goal of conflict scholars. Instead, a key motivation for most peace and conflict research has been to anticipate conflicts in order to prevent their escalation. But while understanding or explaining the past and predicting the future are closely related processes that feed into each other, they are still two different endeavours. In the past decade, the field of conflict studies has seen increasing debates over the distinction between explanation and prediction and the implications of this distinction for research (Ward *et al*. 2010). From these debates, a subfield has emerged within conflict studies that is dedicated to prediction specifically.

Civil wars are a hard target to predict, as the introductory quote by one prediction expert illustrates. First, they are still a comparatively rare event. As a result, civil war predictioneers have to learn from a few past events, and can evaluate their models only irregularly. This is fundamentally different from the field of weather forecasting, for instance, where new data is available to test and update predictive models on a constant basis (Schrodt *et al*. 2013: 155). Second, and unlike in election forecasting, where people participate in an institutionalized process and pre-election surveys of their opinions and intentions are available, civil wars are by definition the result of people breaking rules, for obvious reasons with little incentive to provide voluntary information on their intention to do so (Ulfelder 2012). Third, human behaviour more generally ranges from very predictable to highly unpredictable (Hofman *et al*. 2017: 487), and it is often the unpredictable behaviour that presents a trigger event, which spirals out of control and makes the start of a war in retrospect look like an idiosyncratic social process that was impossible to foresee.

The self-immolation of Mohamed Bouazizi, a 26-year old Tunisian fruit vendor who set himself on fire after the authorities confiscated his wares and humiliated him, is an often cited example of such an unpredictable event that triggered a chain of events leading down the road to the so-called Arab Spring and civil wars in Syria, Libya, and Yemen (e.g. Worth 2011; Tetlock and Gardner 2015: 8). It is from such examples that prediction sceptics draw their conclusion that civil wars are unpredictable (Goodwin 2011; Jäger 2016). But low predictability is not the same as unpredictability, and although the jury is still out on where the limits of conflict prediction are (Chadefaux 2017), conflict scholars have set out to try and test these limits rather than 'preemptively declare defeat at the forecasting task' (Ward *et al*. 2013: 487). This chapter describes these efforts to predict civil wars and related forms of political violence, with a focus on their shared standards and epistemological foundations, the rapid methodological development that characterizes the field, and the open question of how academic civil war prediction can and should influence policy-making.

The establishment of a prediction paradigm and subfield

It was only in the mid to late 2000s that conflict prediction came to be viewed as an actual and mainstream subdiscipline of conflict research (Hegre, Metternich *et al*. 2017: 115).[2] This subfield has subscribed to the positivist paradigm of scientific research and borrows heavily from natural-scientific and mathematical approaches to prediction: The social processes and phenomena of interest are quantified, and large datasets and sophisticated computational techniques are used to predict the future.

This epistemology of forecasting violence fits in with a general trend towards quantitative methods in conflict studies (Clayton 2014), but in the prediction subfield, it is near-exclusive. Bernstein *et al*. (2000) offer a fundamental critique of this approach which rests, as they argue, on a 'mistaken analogy between physical and social phenomena' (2000: 43), and suggest that the study of international relations compares best with evolutionary biology – an open system that changes and evolves in random ways, making prediction impossible. At this stage, however, this debate has not made notable inroads in the prediction subfield. This is not to say that the limits of quantitative approaches to prediction or even the predictability of civil wars altogether are not discussed (for instance, Cederman and Weidmann 2017; Chadefaux 2017), but there is little epistemological debate between proponents of alternative approaches to social science in the violence forecasting field.[3]

Alternative approaches like forecasts based on in-depth knowledge of individual cases, which dominated conflict forecasting for most of the post-World War II period (Goldstone 2008), have in fact come to play a side role altogether. While they have the advantage that they can also take into account factors and processes that are not easily quantifiable (status, perceptions, personality of leaders, etc.), their credibility – at least in mainstream conflict research – has

been weakened by studies showing that the predictive performance of experts on geopolitical events is barely better than random guessing, and that merely teaching laypeople some basics of statistics makes their predictions superior to expert forecasts (Tetlock 2005; Green and Armstrong 2007; Tetlock and Gardner 2015). This has further led quantitatively inclined conflict scholars to strive for a more 'scientific' approach to prediction in which computers would help overcome the human biases that hamper expert judgement (Goldstone 2008). After all, if laypeople could be trained to make better predictions through simple probability theory, so should statistical models (Ward 2016).[4]

The field of conflict prediction in its current form accordingly owes a lot to early efforts to systematically collect conflict data that would make wars comparable for explanation and prediction.[5] One of the first comprehensive datasets came out of the Correlates of War project, founded in 1963 by J. David Singer (Correlates of War Project 2017). The project is rightfully considered to have set the 'gold standard of quantitative conflict research in the twentieth century' (Ward *et al*. 2013: 475). Singer also co-edited a pioneering volume on early warning indicators in world politics (Singer and Wallace 1979), but the focus of this work (and most other work in conflict research at the time) was on conflict between, rather than within, states. The only chapter that focused on intra-state conflict was authored by Ted Gurr and Mark Lichbach, two authors who a couple of years later published what Ward (2016: 81) has identified as the first empirical study of intra-state conflict that focuses *explicitly* on forecasts. In Gurr and Lichbach (1986: 3) the authors criticize previous empirical research on conflict as postdictive rather than predictive in that 'they can offer plausible explanations after the fact for the occurrence of episodes of rioting or revolution, but they are not used to make forecasts or probability statements about the occurrence of future conflict'. And indeed, most conflict research treated *understanding* and *explaining* past conflicts as equivalent to *anticipating* future ones.

Although that idea was challenged occasionally (for instance by King and Zeng 2001), it was not until an article by Ward *et al*. (2010) that the fundamental distinction between explanation and prediction reached a broader audience of conflict researchers. The authors argued that risk factors identified as important explanations of past conflict in one dataset are not automatically also good predictors of future conflict. They may fail to predict conflict in previously unseen data if they have captured only small effects (Hegre, Metternich *et al*. 2017: 116) or if the model suffers from overfitting, that is, a model has 'learned' the data at hand too well and explains its idiosyncrasies rather than underlying causal relationships. To avoid this, Ward *et al*. (2010) promoted the out-of-sample evaluation of models – a process by which models are tested on data that was not used to create them in the first place. What drove the message home is that the authors subjected two of the most widely cited models of civil war onset (Fearon and Laitin 2003; Collier and Hoeffler 2004) to out-of-sample testing and found that their contribution to predicting future conflict was massively less impressive than the theoretical claims the authors had made on the basis of their

statistically significant findings. Since then, out-of-sample predictions are a crucial part of what could be termed a conflict prediction paradigm: a commitment to the scientific method, and a consensus on that and how the performance of predictions is evaluated.

Forecasting the onset of war: the standard procedure

The goal of civil war prediction is to make a statement of where and when civil wars are likely to break out in the future based on information on the causes and triggers of civil wars that happened in the past. Because civil wars are often the result of a process of escalating violence, quantitative conflict scholars usually define a casualty threshold for establishing when a war is considered to have started in their conflict datasets. Common thresholds are 25 battle-deaths in a year for civil conflicts and 1,000 battle-deaths in a year for civil wars.[6] The researcher then decides whether to predict the onset of war or its incidence. Both are binary outcomes, but in onset predictions only the start of a war is of interest, whereas studies of incidence predict whether a country will be in a war-state or not in any period of time, including years or months following the onset.

The prediction of these binary outcomes follows three steps, illustrated in Figure 11.1. The first two steps – model creation and model validation – require data on conflicts that have already happened; only the third step is a forecast into the 'real' future. For the first two steps, the available data is divided into two sets: a training set and a test set. The training set is used to estimate a model that links predictors with the outcome, i.e. establishes what type of characteristics tend to be present when wars start, or what type of events precede the onset of war. This step is no different from the standard procedure of *explaining* wars. What sets prediction apart from explanation is that the researcher has set aside data for a test of the model. Hegre, Nygård and Flaten Ræder (2017), for instance, estimate their model of global conflict incidence on data for the years 1950–2001, and test the predictive performance of the model for the years 2002–14. This is the 'as if' future, i.e. the researchers pretend they do not know the wars that started between 2002 and 2014, but because this data is in reality already in the past, they can test whether the model correctly predicts instances of conflicts that were not used to create the model. This is the out-of-sample or model validation step. Only in the last step is this model used to forecast conflicts into the 'real' future. The challenge in this part of the process is that researchers neither know the outcome (which wars will start), nor the values on the independent variables (predictors). They have to make assumptions about how the risk factors for war will develop in the future, and they can do that by extrapolating trends from the past or by using scenarios to account for different possible developments (Ward and Beger 2017: 153).

The model validation step is the most crucial part of the prediction process, at least from an academic perspective. Without model validation, scholars have to

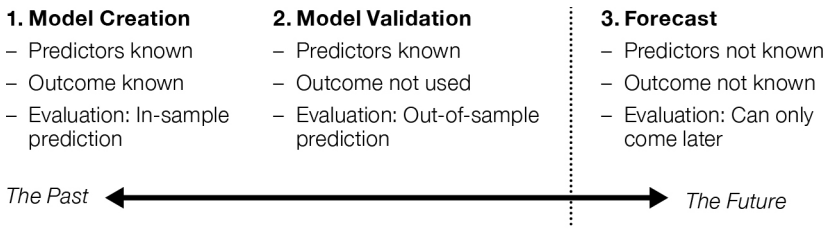

Figure 11.1 A simple model of the standard forecasting process.

wait for the future to assess whether a model predicts well or not. Only from models that have been subject to a test which simulates the future can other scholars and policy-makers get information on whether they should trust the real forecasts. There are various measures to assess and communicate the predictive performance of a model (see, for instance, Ward *et al*. 2013; Ward and Beger 2017). In one way or another, they all assess the ratio of true to false predictions. True predictions are conflicts correctly anticipated (true positives), or the correct prediction that a country will not see conflict (true negatives). Likewise, a model can make two types of mistakes, namely predicting a conflict that did not happen (false positives), or missing an onset that did happen (false negatives). Because most models used to predict civil war estimate a probability of conflict, making a point prediction in the form of a binary 'conflict' or 'no conflict' statement requires researchers to first decide at which estimated probability they are willing to predict an onset (Ward *et al*. 2010: 366–7).[7] There is usually a trade-off in that lowering this threshold leads to more conflicts correctly anticipated, but at the expense of an increasing number of false alarms. One of the most commonly used evaluation metrics, the area under the ROC (Receiver–Operator–Characteristic) curve, therefore assesses the ratio of true to false positives at all possible thresholds (Ward *et al*. 2010).

By employing such evaluation metrics, conflict prediction scholars have agreed on a research ethic which posits that predictions are made explicit and verifiable, and that their performance is transparently reported. This is the field's – occasionally quite explicit – criticism of 'media stars and pundits' (Ward 2016) who resort to vaguely formulated forecasts in order to escape falsification, and rarely keep track of their past performance at all (Tetlock and Gardner 2015).

Epistemological unity, methodological diversity

Some prediction articles in civil war studies follow the template described above almost to the book, such as O'Brien (2002), Rost *et al*. (2009), Hegre *et al*. (2013), Hegre *et al*. (2016), Hegre, Nygård and Flaten Ræder (2017), and Hultman *et al*. (2019). Yet within the epistemological paradigm of scientifically predicting civil wars and political violence, there is considerable variation

between projects on the outcome that is predicted; the spatial and temporal units for which a prediction is made; the type of predictors that are used; and the computational method that links these predictors with the outcome. This variation is reflective of a young field in which rapid methodological development is in full progress.

Besides the onset or incidence of civil war, conflict scholars predict a wide variety of violent outcomes, such as genocide (Harff 2003; Goldsmith *et al*. 2013; Pilster *et al*. 2016), state-led mass killing (Koren 2017), state repression (Gohdes and Carey 2017), phase shifts between violent and nonviolent resistance (Shellman *et al*. 2013), political violence more generally (Weidmann and Ward 2010; Bell *et al*. 2013), irregular leadership changes (Beger *et al*. 2014; Ward and Beger 2017), state failure (King and Zeng 2001), political instability (O'Brien 2002; Goldstone *et al*. 2010; O'Brien 2010), ethnic conflict (Bara 2014; Cederman *et al*. 2017), inter-state conflict (Beck *et al*. 2000; Gleditsch and Ward 2013), or maritime piracy (Daxecker and Prins 2015, 2017a), to list just a few. Increasingly, scholars also aim to go beyond binary outcomes and instead predict the level or intensity of violence (e.g. Bagozzi 2015; van Weezel 2016; Daxecker and Prins 2017b). Finally, conflict scholars also make predictions of more positive or at least non-violent outcomes, such as the start of non-violent resistance (Chenoweth and Ulfelder 2017), the onset and success of mediation (Clayton and Gleditsch 2014), ceasefire success (Schneider *et al*. 2017), quality of domestic governance (Joshi *et al*. 2015), or the international community's conflict management behaviour in international disputes (Owsiak 2015).

In terms of the spatial and temporal resolution of predictions, country-years are a common unit: Based on annually updated information on countries in the past, scholars attempt to predict these countries' risk of conflict in any of several years into the future. Hegre *et al*. (2016), for instance, forecast the incidence of conflict globally as far ahead as the year 2100 using different scenarios on the likely socio-economic development of countries. At the same time, there is a trend towards more fine-grained predictions on the timing and location of violent events. Chadefaux (2014) produces weekly updated three-month forecasts of conflict onset in countries worldwide using early warning signals of conflict in the news, and many articles now produce monthly rather than annual forecasts of the event of interest. To predict the location of violence within a country or conflict, scholars can make use of a growing number of georeferenced datasets. Blair *et al*. (2017), for instance, predict the incidence of local violence in different villages and towns in Liberia, while Cederman *et al*. (2017) make predictions of conflict for particular ethnic groups within a country. Relatedly, Schutte (2017), Hirose *et al*. (2017) and Weidmann and Ward (2010) all predict the location of violence *within* ongoing conflicts. Witmer *et al*. (2017) combine spatial *and* temporal disaggregation: Using different climate change and socio-political development scenarios they forecast monthly levels of political violence between 2015–65 in Sub-Saharan Africa for spatial units as small as 110×110 km.

These ambitions to predict the exact location and timing of conflict also require more detailed and dynamic data on the things believed to fuel – and therefore predict – conflict (for an overview of data types, see Schrodt *et al*. 2013). While some projects achieve high predictive accuracy with purely structural information (an example with only four variables is Goldstone *et al*. 2010), factors like GDP, regime characteristics, or population change only slowly and can primarily help distinguish between countries that are at risk and those that are not (Schneider *et al*. 2011: 9). To predict when this risk materializes and even anticipate escalation processes in real time, scholars use dynamic event and sentiment data in their models and have developed automated data extraction and coding algorithms to handle the mass of information they are dealing with (Schrodt 2012). Examples are Ward *et al*. (2013), who integrate structural and event data, or D'Orazio and Yonamine (2015), who look for similarities between *sequences* of events (interactions between state and non-state actors) in the lead-up to conflict. Jäger (2016: 349–50) has criticized such approaches as banal on the grounds that they predict the thing they want to predict by using nothing but earlier manifestations of the very same thing. This, however, is only a problem if the goal of the exercise is to identify *causal* factors, whereas early warning projects look for reliable *signals* of conflicts that may have already started or are about to start (Hegre, Metternich *et al*. 2017: 117). For such signals, scholars are also exploring sentiment data extracted from social media to get access to people's feelings, motivations, or mobilization efforts. Although such data have disadvantages in terms of bias and manipulation (Schrodt *et al*. 2013: 136), this is perhaps as close as conflict prediction gets to an equivalent of polling data used in election forecasts.

To connect these various types of input data with the outcome to predict, scholars use different computational approaches with at times quite different results if the same data is analysed with several models (for a side-by-side comparison, see King and Zeng 2001; Rost *et al*. 2009). Two broad classes can be distinguished: statistical models (such as regression analysis) and algorithmic (machine learning) approaches (Schrodt *et al*. 2013). Both have the same aim, namely to learn from past data. But in a statistical model, the researcher needs to specify a mathematical equation to 'tell' the model how the different predictors are assumed to be interrelated. What the model learns from the data is the presence and strength of relationships between the individual predictors and the outcome. In machine learning approaches, the computer learns the structure of the data by itself and uses this information to predict the outcome. This, coupled with the ability of machine learning algorithms to handle vast amounts of data, make this an attractive approach for conflict prediction (Schrodt *et al*. 2013: 145). A drawback is that results from algorithmic approaches are not easy to interpret, i.e. information about the most important conflict predictors are hard to extract from the model (Cederman and Weidmann 2017: 476; Hegre, Metternich *et al*. 2017: 117). Exactly this information, however, may be crucial for policy-makers who want to know *what* could mitigate the risk of future conflict.

Conflict prediction and policy

In this context of algorithmic approaches, the old debate on the value of explanation versus prediction comes full circle: Prediction without explanation is possible, but predictions that come with explanations may be more policy-relevant (Ward and Beger 2017: 149).[8] The needs of policy-makers and the logic of academic violence prediction also diverge somewhat in terms of the output produced: Most published prediction articles in the area of political violence skip the last step of the standard forecasting process described above, that is, they do not forecast into the real future. Instead, they stop at the step of model evaluation, in which the main aim is to demonstrate a model's accuracy in comparison to the real outcome, a measure that is important for the acceptance of a project's data or methodology in the academic community.

Policy-makers, on the other hand, would arguably be more interested in predictions of events or trends that are truly unknown (Schneider *et al*. 2011, 7–8). This mismatch has its roots in academic incentive structures: Scientific journals primarily publish theoretical or methodological innovations and are less inclined to publish regular forecasts into the future. If real-time prediction is desired, interested entities will accordingly have to fund these efforts. Examples of such funding that has yielded publicly available real-time forecasts are the *CoupCast* project by One Earth Future (OEF) Research, the US Holocaust Memorial Museum's *Early Warning Project*, and the EU-funded *Violence Early-Warning System (ViEWS)* project at Uppsala University.[9]

How the exchange between academics and policy-makers in the prediction of crises and violence should function is an important, but still open question. After all, the endeavour to anticipate future conflicts has been hailed as a means to increase the real-world impact of academic conflict research (Ward *et al*. 2010, 365), to move from basic to applied research (Hegre, Metternich *et al*. 2017: 117), and to live up to expectations from policy-makers and practitioners to 'contribute something useful to society' (Schneider *et al*. 2010: 1). In a recent reflection on the state of the conflict prediction subfield, however, Cederman and Weidmann (2017: 475) concede that 'the field is still far from the policy impact that pollsters and economic forecasters enjoy'. This begs the questions of what it means for conflict prediction scholars to have policy impact, and how a more fruitful collaboration between academia and policy can be established.

Non-academic stakeholders in crisis prediction and early warning are organizations that are either affected by, or responsible to act upon, the outbreak of conflict. This includes governments, international organizations, multinational companies, banks, insurance companies, embassies, and NGOs, among others. Many of them, but especially governments, have their own forecasting capabilities (Ward 2016: 88), and in the business realm, 'political risk analysis' is a flourishing market (Howell 2014). The methods and outcomes of such forecasting efforts outside academia, however, are often not transparent if not outright secret for political or business reasons, and their quality is accordingly hard to gauge (Hegre, Metternich *et al*. 2017: 114).

This issue extends to data. Governments but also international organizations or NGOs collect massive amounts of data that would potentially be of use for crisis prediction,[10] but most of this data is confidential either for political reasons or because local informants have to be protected (Dorn 2009). An example is the detailed UN Joint Mission Analysis Centre (JMAC) data on violent incidents collected by UN peacekeeping mission staff on the ground, most of which is not publicly accessible but has been shown to be more comprehensive and precise than the publicly available violent event data on which most conflict researchers rely (Duursma 2017). At the same time, the organizations collecting this data often do not have the in-house expertise, capacity, or political will to analyse it in a structured manner for early warning purposes (Zenko and Friedman 2011).

It is not surprising then that it is primarily methodological expertise that academic conflict forecasting has brought to the policy world. And this is the competitive advantage of academic conflict prediction and what sets it apart from related efforts outside academia, namely that prediction methods are subject to scrutiny by academic peers, and that they are continuously developed and improved upon. The US government in particular has sponsored several large projects in which it has invited social scientists to contribute to the development of its prediction capacities (Laitin 2014). One early example is the State Failure Task Force initiated in 1994, later renamed the Political Instability Task Force (PITF). The US government tasked the PITF to identify important conflict predictors and to develop a methodology for early warning purposes (O'Brien 2002: 792). The PITF was funded by the CIA, and was a collaboration between government analysts, contractors, and a number of prominent prediction scholars (examples of research that has come out of it include Goldstone *et al*. 2010; Ward and Beger 2017). Another example of such government-sponsored collaboration between scientists, government, and business is the Integrated Crisis Early Warning System (ICEWS) project, which was funded by the US DoD's Defense Advanced Research Projects Agency (DARPA) (O'Brien 2010: 2013).

These examples illustrate that academic conflict forecasting has clearly had influence in the world of policy-makers, but that this influence stems not so much from producing risk forecasts that directly guide actions of policy-makers, but from bringing cutting-edge scientific methods into the realm of policy-makers' own forecasting efforts. In turn, these intelligence- and defence-funded collaborations between government, industry, and academia have clearly also profited academic forecasting efforts in terms of new methods and event datasets, such as the now finally publicly released version of the ICEWS dataset (see Schrodt 2015). Perhaps noteworthy in this context is that in other academic fields, such as neuroscience to give just one example (Tennison and Moreno 2012; Ienca *et al*. 2018), ethical dilemmas that could arise for researchers when participating in military-funded projects are much more extensively discussed, while such debates are not visible in published conflict prediction work. Such questions could be: By whom and to what end is the knowledge brought into

such projects used; how much control do social scientists have over how it is used, and would it be legitimate to provide methodological expertise if control over the end product and end user is not given?

Of course, direct collaboration with government is not the only or even primary mode by which academic violence prediction may influence policy. O'Brien (2010: 98), who led the ICEWS project at the DARPA, identified a more general lack of policy-*relevant* predictions in academic work, defined as predictions that aim to identify risk factors that could be *changed* through government policy or intervention (as opposed to risk factors such as population size, or mountainous terrain). More generally, conflict experts from within and outside academia have identified a lack of predictive research on the likely outcome of alternative policy interventions (sanctions, diplomacy, military action, peace operations, etc.) if an instability onset is forecast or already occurring (O'Brien 2010; Laitin 2014, 118; Hegre, Metternich *et al*. 2017). One example of such a policy impact prediction is Hultman *et al*. (2019)'s simulation of how the global incidence of armed conflict may develop in the long run under different UN peacekeeping scenarios, but such studies are few and far between. There are generally few studies that use scenarios to forecast alternative futures (but see Hegre *et al*. 2013; Hegre *et al*. 2016; Hegre, Nygård and Flaten Ræder 2017), although scenario planning has a long history in government strategic planning (Becker 1983) and may thus be an avenue of collaboration between research and policy.

Concluding remarks

Not even two decades ago, Beck *et al*. (2000: 21) made the tart remark that 'no legitimate statistical model (using annual data) has ever forecast an international conflict with greater than 0.50 probability, and certainly none has done so while also being correct'. In the meantime, academic conflict prediction has made substantial progress, and the field has grown exponentially in the past few years. With a fast improving capacity to harness computational power to extract, code, and analyse large amounts of data on the intentions and behaviour of social actors, this upward trend will likely continue in what for some conflict researchers is now the 'ultimate frontier' (Cederman and Weidmann 2017: 474). Yet are there limits to the prediction of civil war and political violence, or can forecasts get ever more accurate with further progress in the field?

There are sceptical voices. In an article aptly titled 'War is in the Error Term', for instance, Gartzke (2003) posits that rationalist explanations of war – which underpin much theorizing in the field of quantitative conflict studies – themselves predict that the prediction of war is impossible. If wars break out because actors lack information about their opponent's ability or willingness to fight, their onset is logically unpredictable unless we assume that researchers are better informed than the participants themselves. Others point to the limits of statistical prediction in what Taleb (2008) calls the 'danger zone' or 'fourth quadrant' – the area where low probability events carry potentially huge impact,

and where knowledge about the past is fundamentally useless because of discontinuities in causal patterns. While already the emergence of such events is hard to foresee, their potential *impact* is literally unpredictable (see also Taleb and Tetlock 2013). In this sense, civil war scholars have been criticized for going for the easy question of whether a war is likely to occur or not rather than the harder question of whether a war will kill 1,000 or 1 million people (Taleb and Tetlock 2013; Jäger 2016).

Conflict prediction scholars do not discount these arguments, but they are not deterred by them. With regard to the limits of anticipating extreme events, Schneider *et al*. (2010) point out that conflict scholars share this fate with other disciplines such as seismology, which can likewise not foresee the most deadly earthquakes even if it can point to common earthquake precursors and trends. The general consensus appears to be that the limits of prediction are better explored and tested than assumed, even if progress in predicting wars is likely going to be slower than in fields where events happen more often and models can be validated and improved on a more regular basis (Ulfelder 2012; Schrodt *et al*. 2013: 155). Progress may also be uneven across different forecasting ambitions: Cederman and Weidmann (2017: 476), for instance, see most potential in the early warning of more immediate outcomes that are less affected by macro-historical changes, social learning, and unexpected but game-changing events (black swans).

This is not necessarily something bad. Everyone knows that weather forecasts are fairly accurate a few days ahead and become increasingly unreliable the further out the forecast goes. For the large majority of consumers of weather forecasts, this is no problem, as they may be primarily interested in an 'early warning' of rain to pack an umbrella, or in knowing whether to plan a weekend hike. One could argue that weather forecasts are thus most accurate exactly where they are most wanted. But the same could be said for the prediction of conflict: Even if reliable long-term forecasts of major war outbreaks could be made, it would be difficult to muster political will and financial resources to act preventively before something has happened at all. It may be easier to motivate preventive action if early warning mechanisms can credibly show that something is about to happen in the near future.

Besides these debates on the *possibility* of prediction, a parallel debate on the social *desirability* of prediction is conspicuously absent in the discipline.[11] Who uses conflict scholars' forecasts for what purpose, and what government policies or courses of action are justified through them (Wachs 1990)? More generally, what are the ethical concerns and risks of making (both right and wrong) predictions? To a certain extent, this paucity of ethical debate in forecasting conflict and violence may be a consequence of the minor direct policy impact the field has had so far. This is different in fields where predictions are acted upon, such as in predictive policing (see Leese 2020), or in the financial world, where the crisis in 2008 was at least partially blamed on erroneous predictions (Taleb 2008; Silver 2015). So far, conflict prediction has escaped such blame. But once conflict scholars start heeding the call for more predictions on the outcome of

alternative intervention options available to policy-makers, debates on the ethical implications of such predictions and on the impact of being wrong may need to be had.

Notes

1 For two good overviews of what the academic study of civil wars has to say about Syria, see Lynch (2013) and Fisher (2016).
2 In fact, most journal articles on the prediction of conflict and violence were published in the past five years.
3 Partially also because such debates have already been had in the field of conflict studies, from which violence forecasting emerged (for a critique of the scientific approach to conflict studies, see, for instance, Korf 2006).
4 Philip Tetlock, the most prominent head behind the dismantling of expert political judgement, states that the future may lie in a blending of computer-based forecasting and subjective judgement (Tetlock and Gardner 2015, 23). The ViEWS (Violence Early-Warning System) project, an early warning project led by Håvard Hegre at Uppsala University (www.pcr.uu.se/research/views) and funded by the European Research Council (ERC), plans to integrate expert judgement into its data-driven machine learning approach to forecasting in the future (according to Hegre at the ViEWS launch event, 7 June 2018, Uppsala University).
5 For more complete reviews of the history of conflict prediction see, for example, Hegre, Metternich *et al*. (2017), Ward *et al*. (2013), Schrodt *et al*. (2013) or Ward (2016).
6 This holds for the two most commonly used conflict datasets, the UCDP/PRIO Armed Conflict Dataset (http://ucdp.uu.se/downloads) and the Correlates of War data (www.correlatesofwar.org).
7 Note that although binary predictions (conflict yes/no) have been the standard practice, more fine-grained predictions are possible. Hegre *et al*. (2013), for instance, make a three-category prediction (no conflict, minor conflict, major conflict), and the probabilities returned by statistical models also lend themselves to continuous predictions (chance of conflict between 0 and 100 per cent). With more complex classification, however, both the communication of predictions and their evaluation get more complex. Predictions are not simply right or wrong anymore, but 'more or less' off the target, which influences the choice of evaluation metrics.
8 This is arguably less important for early warning purposes, where it is not paramount to know why a conflict is about to escalate, just that it is (Hegre, Metternich *et al*. 2017).
9 CoupCast: http://oefresearch.org/activities/coup-cast; Early Warning Project: www.earlywarningproject.org; ViEWS: www.pcr.uu.se/research/views. I thank Håvard Hegre for bringing this issue of incentive structures to my attention.
10 But see Fast (2017) or Perera (2017) for an engagement with the problem of uncritical data enthusiasm both in academia and if used to guide policy and action on the ground.
11 Even a systematic search for work on conflict prediction or forecasting in journals known for publishing a high number of critical or post-positivist work (thanks to Myriam Dunn, Ursula Jasper, and Aglaya Snetkov for suggestions) yielded no relevant result.

References

Al Jazeera (2018) 'Syria's Civil War Explained from the Beginning', *Al Jazeera*, 14 April. Online. Available: www.aljazeera.com/news/2016/05/syria-civil-war-explained-160505084119966.html (accessed 5 March 2019).

Bagozzi, B. E. (2015) 'Forecasting Civil Conflict with Zero-Inflated Count Models', *Civil Wars* 17(1): 1–24.

Bara, C. (2014) 'Incentives and Opportunities: A Complexity-Oriented Explanation of Violent Ethnic Conflict', *Journal of Peace Research* 51(6): 696–710.

Beck, N., King, G. and Zeng, L. (2000) 'Improving Quantitative Studies of International Conflict: A Conjecture', *American Political Science Review* 94(1): 21–35.

Becker, H. S. (1983) 'Scenarios: A Tool of Growing Importance to Policy Analysts in Government and Industry', *Technological Forecasting and Social Change* 23(2): 95–120.

Beger, A., Dorff, C. L. and Ward, M. D. (2014) 'Ensemble Forecasting of Irregular Leadership Change', *Research and Politics* 1(3): 1–7.

Bell, S. R., Cingranelli, D., Murdie, A. and Caglayan, A. (2013) 'Coercion, Capacity, and Coordination: Predictors of Political Violence', *Conflict Management and Peace Science* 30(3): 240–62.

Bernstein, S., Lebow, R. N., Gross Stein, J. and Weber, S. (2000) 'God Gave Physics the Easy Problems: Adapting Social Science to an Unpredictable World', *European Journal of International Relations* 6(1): 43–76.

Blair, R. A., Blattman, C. and Hartman, A. (2017) 'Predicting Local Violence: Evidence from a Panel Survey in Liberia', *Journal of Peace Research* 54(2) 298–312.

Cederman, L.-E. and Weidmann, N. B. (2017) 'Predicting Armed Conflict: Time to Adjust Our Expectations?', *Science* 355(6324): 474–6.

Cederman, L.-E., Gleditsch, K. S. and Wucherpfennig, J. (2017) 'Predicting the Decline of Ethnic Civil War', *Journal of Peace Research* 54(2): 262–74.

Chadefaux, T. (2014) 'Early Warning Signals for War in the News', *Journal of Peace Research* 51(1): 5–18.

Chadefaux, T. (2017) 'Conflict Forecasting and Its Limits', *Data Science* 1(1–2): 7–17.

Chenoweth, E. and Ulfelder, J. (2017) 'Can Structural Conditions Explain the Onset of Nonviolent Uprisings?', *Journal of Conflict Resolution* 61(2): 298–324.

Clayton, G. (2014) 'Quantitative and Econometric Methodologies', in E. Newman and K. DeRouen Jr. (eds) *Routledge Handbook of Civil Wars*, London and New York: Routledge, 28–40.

Clayton, G. and Gleditsch, K. S. (2014) 'Will We See Helping Hands? Predicting Civil War Mediation and Likely Success', *Conflict Management and Peace Science* 31(3): 265–84.

Collier, P. and Hoeffler, A. (2004) 'Greed and Grievance in Civil War', *Oxford Economic Papers* 56(4): 563–95.

Correlates of War Project (2017) 'History'. Online. Available: www.correlatesofwar.org/history (accessed 5 March 2019).

D'Orazio, V. and Yonamine, J. E. (2015) 'Kickoff to Conflict: A Sequence Analysis of Intra-State Conflict-Preceding Event Structures', *PLoS ONE* 10(5): 21.

Daxecker, U. E. and Prins, B. C. (2015) 'The New Barbary Wars: Forecasting Maritime Piracy', *Foreign Policy Analysis* 11(1): 23–44.

Daxecker, U. E. and Prins, B. C. (2017a) 'Enforcing Order: Territorial Reach and Maritime Piracy', *Conflict Management and Peace Science* 34(4): 359–79.

Daxecker, U. E. and Prins, B. C. (2017b) 'Financing Rebellion', *Journal of Peace Research* 54(2): 215–30.

Dorn, A. W. (2009) 'Intelligence-Led Peacekeeping: The United Nations Stabilization Mission in Haiti (MINUSTAH), 2006–07', *Intelligence and National Security* 24(6): 805–35.

Duursma, A. (2017) 'Counting Deaths While Keeping Peace: An Assessment of the JMAC's Field Information and Analysis Capacity in Darfur', *International Peacekeeping* 24(5): 823–47.

Fast, L. (2017) 'Diverging Data: Exploring the Epistemologies of Data Collection and Use among Those Working on and in Conflict', *International Peacekeeping* 24(5): 706–32.

Fearon, J. D. and Laitin, D. D. (2003) 'Ethnicity, Insurgency, and Civil War', *American Political Science Review* 97(1): 75–90.

Fisher, M. (2016) 'Syria's Paradox: Why the War Only Ever Seems to Get Worse', *The New York Times*, 26 August. Online. Available: www.nytimes.com/2016/08/27/world/middleeast/syria-civil-war-why-get-worse.html (accessed 5 March 2019).

Gartzke, E. (2003) 'War Is in the Error Term', *International Organization* 53(3): 567–87.

Gleditsch, K. S. and Ward, M. D. (2013) 'Forecasting Is Difficult, Especially about the Future: Using Contentious Issues to Forecast Interstate Disputes', *Journal of Peace Research* 50(1): 17–31.

Gohdes, A. R. and Carey, S. C. (2017) 'Canaries in a Coal-Mine? What the Killings of Journalists Tell Us about Future Repression', *Journal of Peace Research* 54(2): 157–74.

Goldsmith, B. E., Butcher, C. R., Semenovich, D. and Sowmya, A. (2013) 'Forecasting the Onset of Genocide and Politicide: Annual Out-Of-Sample Forecasts on a Global Dataset, 1988–2003', *Journal of Peace Research* 50(4): 437–52.

Goldstone, J. A. (2008) 'Using Quantitative and Qualitative Models to Forecast Instability', *USIP Special Report 204*, Washington, DC: United States Institute of Peace (USIP).

Goldstone, J. A., Bates, R. H., Epstein, D. L., Gurr, T. R., Lustik, M. B., Marshall, M. G., Ulfelder, J. and Woodward, M. (2010) 'A Global Model for Forecasting Political Instability', *American Journal of Political Science* 54(1): 190–208.

Goodwin, J. (2011) 'Why We Were Surprised (Again) by the Arab Spring', *Swiss Political Science Review* 17(4): 452–6.

Green, K. C. and Armstrong, J. S. (2007) 'The Ombudsman: Value of Expertise for Forecasting Decisions in Conflicts', *Interfaces* 37(3): 287–99.

Gurr, T. R. and Lichbach, M. I. (1986) 'Forecasting Internal Conflict: A Competitive Evaluation of Empirical Theories', *Comparative Political Studies* 19(1): 3–38.

Harff, B. (2003) 'No Lessons Learned from the Holocaust? Assessing Risks of Genocide and Political Mass Murder since 1955', *The American Political Science Review* 97(1): 57–73.

Hegre, H., Buhaug, H., Calvin, K. V., Nordkvelle, J., Waldhoff, S. T. and Gilmore, E. (2016) 'Forecasting Civil Conflict along the Shared Socioeconomic Pathways', *Environmental Research Letters* 11(5):1–8.

Hegre, H., Karlsen, J., Nygård, H. M., Strand, H. and Urdal, H. (2013) 'Predicting Armed Conflict, 2010–2050', *International Studies Quarterly* 57(2): 250–70.

Hegre, H., Metternich, N. W., Nygård, H. M. and Wucherpfennig, J. (2017) 'Introduction', *Journal of Peace Research* 54(2): 113–24.

Hegre, H., Nygård, H. M. and Flaten Ræder, R. (2017) 'Evaluating the Scope and Intensity of the Conflict Trap', *Journal of Peace Research* 54(2): 243–61.

Hirose, K., Imai, K. and Lyall, J. (2017) 'Can Civilian Attitudes Predict Insurgent Violence? Ideology and Insurgent Tactical Choice in Civil War', *Journal of Peace Research* 54(1): 47–63.

Hofman, J. M., Sharma, A. and Watts, D. J. (2017) 'Prediction and Explanation in Social Systems', *Science* 355(6324): 486–8.

Howell, L. D. (2014) 'Evaluating Political Risk Forecasting Models: What Works?', *Thunderbird International Business Review* 56(4): 305–16.

Hultman, L., Nygård, H. M. and Hegre, H. (2019) 'Evaluating the Conflict-Reducing Effect of UN Peacekeeping Operations', *The Journal of Politics 81*(1): 215–32.

Ienca, M., Jotterand, F. and Elger, B. S. (2018) 'From Healthcare to Warfare and Reverse: How Should We Regulate Dual-Use Neurotechnology?', *Neuron* 97(2): 269–74.

Jäger, K. (2016) 'Not a New Gold Standard: Even Big Data Cannot Predict the Future', *Critical Review* 28(3–4): 335–55.

Joshi, D. K., Hughes, B. B. and Sisk, T. D. (2015) 'Improving Governance for the Post-2015 Sustainable Development Goals: Scenario Forecasting the Next 50 years', *World Development* 70: 286–302.

King, G. and Zeng, L. (2001) 'Improving Forecasts of State Failure', *World Politics* 53(4): 623–58.

Koren, O. (2017) 'Means to an End: Pro-Government Militias as a Predictive Indicator of Strategic Mass Killing', *Conflict Management and Peace Science* 34(5): 461–84.

Korf, B. (2006) 'Cargo Cult Science, Armchair Empiricism and the Idea of Violent Conflict', *Third World Quarterly* 27(3): 459–76.

Laitin, D. D. (2014) 'America Needs a Council of International Strategy', *Monkey Cage*, 14 October. Online. Available: www.washingtonpost.com/news/monkey-cage/wp/2014/10/14/america-needs-a-council-of-international-strategy/?utm_term=.97bc9af4595a (accessed 5 March 2019).

Leese, M. (2020) ' "We Do That Once per Day": Cyclical Futures and Institutional Ponderousness in Predictive Policing', in A. Wenger, U. Jasper and M. Dunn Cavelty (eds) *Probing and Governing the Future: The Politics and Science of Prevision*, London and New York: Routledge, 213–25.

Lynch, M. (2013) 'The Political Science of Syria's War', *Foreign Policy*, 19 December. Online. Available: https://foreignpolicy.com/2013/12/19/the-political-science-of-syrias-war (accessed 5 March 2019).

O'Brien, S. P. (2002) 'Anticipating the Good, the Bad, and the Ugly: An Early Warning Approach to Conflict and Instability Analysis', *The Journal of Conflict Resolution* 46(6): 791–811.

O'Brien, S. P. (2010) 'Crisis Early Warning and Decision Support: Contemporary Approaches and Thoughts on Future Research', *International Studies Review* 12(1): 87–104.

O'Brien, S. P. (2013) 'A Multi-Method Approach for Near Real Time Conflict and Crisis Early Warning', in V. S. Subrahmanian (eds) *Handbook of Computational Approaches to Counterterrorism*, New York: Springer, 401–18.

Owsiak, A. P. (2015) 'Forecasting Conflict Management in Militarized Interstate Disputes', *Conflict Management and Peace Science* 32(1): 50–75.

Perera, S. (2017) 'To Boldly Know: Knowledge, Peacekeeping and Remote Data Gathering in Conflict-Affected States', *International Peacekeeping* 24(5): 803–22.

Pilster, U., Bohmelt, T. and Tago, A. (2016) 'The Differentiation of Security Forces and the Onset of Genocidal Violence', *Armed Forces and Society* 42(1): 26–50.

Rost, N., Schneider, G. and Kleibl, J. (2009) 'A Global Risk Assessment Model For Civil Wars', *Social Science Research* 38(4): 921–33.

Schneider, G., Gleditsch, N. P. and Carey, S. (2010) 'Exploring the Past, Anticipating the Future: A Symposium', *International Studies Review* 12(1): 1–7.

Schneider, G., Gleditsch, N. P. and Carey, S. (2011) 'Forecasting in International Relations', *Conflict Management and Peace Science* 28(1): 5–14.

Schneider, G., Hadar, M. and Bosler, N. (2017) 'The Oracle or the Crowd? Experts Versus the Stock Market in Forecasting Ceasefire Success in the Levant', *Journal of Peace Research* 54(2): 231–42.

Schrodt, P. A. (2012) 'Precedents, Progress, and Prospects in Political Event Data', *International Interactions* 38(4): 546–69.

Schrodt, P. A. (2015) 'Seven Observations on the Newly Released ICEWS Data', *Asecondmouse, 30 March.* Online. Available: https://asecondmouse.wordpress.com/2015/03/30/seven-observations-on-the-newly-released-icews-data (accessed 5 March 2019).

Schrodt, P. A., Yonamine, J. and Bagozzi, B. E. (2013) 'Data-Based Computational Approaches to Forecasting Political Violence', in V. S. Subrahmanian (eds) *Handbook of Computational Approaches to Counterterrorism*. New York, NY: Springer, 129–62.

Schutte, S. (2017) 'Regions at Risk: Predicting Conflict Zones in African Insurgencies', *Political Science Research and Methods* 5(3): 447–65.

Shellman, S. M., Levey, B. P. and Young, J. K. (2013) 'Shifting Sands: Explaining and Predicting Phase Shifts by Dissident Organizations', *Journal of Peace Research* 50(3): 319–36.

Silver, N. (2015) *The Signal and the Noise: Why So Many Predictions Fail – but Some Don't*, New York, NY: Penguin Group.

Singer, J. D. and Wallace, M. D. (1979) *To Augur Well: Early Warning Indicators in World Politics*, Beverly Hills, CA: Sage.

Taleb, N. N. (2008) 'The Fourth Quadrant: A Map of the Limits of Statistics', *Edge*, 14 September. Online. Available: www.edge.org/conversation/the-fourth-quadrant-a-map-of-the-limits-of-statistics (accessed 5 March 2019).

Taleb, N. N. and Tetlock, P. E. (2013) 'On the Difference between Binary Prediction and True Exposure with Implications for Forecasting Tournaments and Decision Making Research', *Unpublished Manuscript.* Online. Available: www.stat.berkeley.edu/~aldous/157/Papers/taleb_tetlock.pdf (accessed 5 March 2019).

Tennison, M. N. and Moreno, J. D. (2012) 'Neuroscience, Ethics, and National Security: The State of the Art', *PLoS Biology* 10(3): e1001289.

Tetlock, P. E. (2005) *Expert Political Judgment: How Good Is It? How Can We Know?*, Princeton, NJ: Princeton University Press.

Tetlock, P. E. and Gardner, D. (2015) *Superforecasting: The Art and Science of Prediction*, New York, NY: Broadway Books.

Ulfelder, J. (2012) 'Why the World Can't Have a Nate Silver', *Foreign Policy*, 8 November. Online. Available: http://foreignpolicy.com/2012/11/08/why-the-world-cant-have-a-nate-silver (accessed 5 March 2019).

van Weezel, S. (2016) 'Food Imports, International Prices, and Violence in Africa', *Oxford Economic Papers–New Series* 68(3): 758–81.

Wachs, M. (1990) 'Ethics and Advocacy in Forecasting for Public Policy', *Business and Professional Ethics Journal* 9(1/2): 141–57.

Ward, M. D. (2016) 'Can We Predict Politics? Toward What End?', *Journal of Global Security Studies* 1(1): 80–91.

Ward, M. D. and Beger, A. (2017) 'Lessons from Near Real-Time Forecasting of Irregular Leadership Changes', *Journal of Peace Research* 54(2): 141–56.

Ward, M. D., Greenhill, B. D. and Bakke, K. M. (2010) 'The Perils of Policy by P-Value: Predicting Civil Conflicts', *Journal of Peace Research* 47(4): 363–75.

Ward, M. D., Metternich, N. W. Dorff, C. L., Gallop, M., Hollenbach, F. M., Schultz, A. and Weschle, S. (2013) 'Learning from the Past and Stepping into the Future:

Toward a New Generation of Conflict Prediction', *International Studies Review* 15(4): 473–90.

Weidmann, N. B. and Ward, M. D. (2010) 'Predicting Conflict in Space and Time', *Journal of Conflict Resolution* 54(6): 883–901.

Witmer, F. D., Linke, A. M., O'Loughlin, J. Gettelman, A. and Laing, A. (2017) 'Sub-national Violent Conflict Forecasts for Sub-Saharan Africa, 2015–65, Using Climate-Sensitive Models', *Journal of Peace Research* 54(2): 175–92.

Worth, R. F. (2011) 'How a Single Match Can Ignite a Revolution', *The New York Times*, 21 January. Online. Available: www.nytimes.com/2011/01/23/weekinreview/23worth.html (accessed 5 March 2019).

Zenko, M. and Friedman, R. R. (2011) 'UN Early Warning for Preventing Conflict', *International Peacekeeping* 18(1): 21–37.

12 Predicting nuclear weapons proliferation[1]

Jonas Schneider

The question of whether the number of states possessing a nuclear weapons arsenal will increase, decline, or remain constant has been an important concern for foreign and defence policy planners throughout the nuclear age. Given the vast destructive power of these weapons and the politico-military benefits they confer (Bell 2015), governments' assessments of what the global nuclear landscape would look like in five or ten years frequently had a strong bearing on how they viewed their nation's future geopolitical position and threat environment. For example, when World War II was drawing to a close, influential US policy-makers believed the American nuclear monopoly would persist for many years. Based on this estimate, they expected a US preponderance of power that would for decades give Washington an ultimate edge over its non-nuclear rivals (Maddock 2010: 22–45). At the other extreme, in the mid-1960s US defence planners anticipated a widespread proliferation of nuclear weapons over the next decade and, as a result, feared that US geopolitical influence might drastically decline (Gavin 2004/05: 104–7, 128–9).

As with other weapons, predicting the proliferation of nuclear weapons has typically been the task of nations' intelligence services. Specifically, the task of predicting the spread of nuclear weapons *in the world*, as opposed to predicting one country's nuclear trajectory, has mostly been undertaken by the intelligence agencies of major powers, such as the United States and Great Britain (Bollfrass 2017: 33–4). For that reason, this chapter will look into the efforts of the US intelligence community to predict the global spread of nuclear weapons.

Studying the US case as an important example, the chapter identifies a strong propensity among intelligence services to *overestimate* the number of countries that would acquire the bomb. It argues that this tendency reflects the way intelligence agencies deal with uncertainty. Specifically, when analysts estimate the future proliferation behaviour of states yet lack reliable intelligence on the latter's intentions – which is often the case – they place too much emphasis on states' capability to develop the bomb. This inference, in turn, favours exaggerated appraisals of whether states will actually acquire a nuclear arsenal. On the other hand, this effect vanishes once analysts have good evidence on proliferators' intentions.

Understanding how the US intelligence community overestimates proliferation risks is not only intriguing for scholars of the nuclear age, but also consequential

for practical policy. As the chapter shows, at critical junctures in the past, when proliferation shocks vastly increased uncertainty about the future environment, US policy-makers responded to pessimistic predictions by bolstering the nonproliferation regime, thus building the pillars of today's global nuclear order.

The chapter proceeds in five steps. The first section defines proliferation and highlights five characteristics of nuclear politics and technology that make predicting states' proliferation behaviour particularly challenging. The second section describes the accuracy of US intelligence estimates of global proliferation trends. To explain how the analysts overpredicted proliferation, the third section musters evidence showing an unwarranted focus of US intelligence on capabilities, which often favours overestimates. The fourth section shows how ominous predictions informed crucial US policy initiatives that reinvigorated the nonproliferation regime. The last section puts the US track record of overprediction into perspective.

The nature of the beast: the dual-use problem, ambivalence, and proliferation

Nuclear proliferation is commonly defined as the spread of nuclear weapons to states that did not previously have them. Today, between 40 and 50 nations are considered nuclear-capable (ElBaradei 2004; Debs and Monteiro 2017: 332). Crucially, being nuclear-capable does not necessarily mean that a country possesses all the technologies and materials required for building the bomb (Sagan 2010). This latter stage of development is called nuclear *latency*, and Japan is often cited as the prime example of such a latent nuclear power (Fuhrmann and Tkach 2015). In contrast, *nuclear-capable* nations possess the industrial base, technological expertise, and economic resources that enable them to produce the technologies and materials necessary to develop nuclear arms. Hence, nuclear-capable states have the potential to become latent, but can choose not to go down this road. Two important examples of nations that are deemed nuclear-capable but do not yet possess nuclear latency are South Korea (Fitzpatrick 2016: 26–36) and Saudi Arabia (Lewis 2015).

Of the 40 to 50 nuclear-capable states, some 35 have, at one point or another, embarked upon the path leading toward nuclear weapons. However, only ten of them have acquired a nuclear arsenal. The remaining 25 or so countries have abandoned their nuclear weapons activities before building a nuclear explosive device (Müller and Schmidt 2010; Mikoyan 2012; Santoro 2017). Predicting the proliferation behaviour of the 40 to 50 capable nations has proven particularly challenging for several reasons, many of which are related to the nature of nuclear technology and the politics of proliferation.

First, since a good explanation for why such nations build nuclear weapons has proven elusive, analysts cannot accurately predict behaviour based on some observable conditions (Bell 2016). The conventional wisdom during the Cold War was that states sought a nuclear arsenal for loosely specified national security reasons. However, this simplification did not find empirical support, and

it has been found wanting by later research (for reviews, see Sagan 1996/97; Potter and Mukhatzhanova 2008). Neither academic work nor, for all we know, research conducted within government has managed to arrive at a new consensus on the causes of proliferation, however (Chernoff 2014: 62–122). Yet in the absence of an explanation, intelligence analysts do not know which potential causal factors they should pay attention to.

Second, the dual-use character of nuclear equipment – the fact that most of the technologies and materials needed to build nuclear weapons are also useful for peaceful nuclear programmes – makes it difficult for outside analysts to discern whether a nuclear-capable state is 'really' intent on building a nuclear arsenal. In particular, it is entirely possible that nuclear facilities which were built for peaceful purposes are later converted to facilitate a nuclear weapons project. What is more, even if certain technologies were acquired with a nuclear weapons option clearly in mind, possessing them can usually easily be justified vis-à-vis the international community with their potential use in civilian applications. Notably, it is impossible to refute such false declarations through logical arguments alone – that is, without additional intelligence that persuasively documents the state's military nuclear goals (Acton 2009).

Third, complicating things further, the leaders of capable nations might not have strong and well-developed intentions in the nuclear field *at all*: They may cultivate a 'nuclear ambivalence' (Abraham 1999) as the dual-use nature of the infrastructure does not force them to commit their country's nuclear programme to *either* peaceful *or* military goals until very late in the process. There are thus usually mixed signals during this period, with certain domestic constituencies pushing for the bomb, while others oppose such ideas. With the political leadership undecided, foreign intelligence services cannot guess who is going to win this internal debate.

Fourth, the pervasive secrecy surrounding nuclear weapons activities makes it hard to get inside information about countries' nuclear ambitions. Proliferators have typically kept quiet about their weapons projects until after their first nuclear test; and Israel and Apartheid South Africa did not reveal any information about their nuclear ambitions even after acquiring and stockpiling weapons (Cohen and Frankel 1990). Moreover, as proliferators' understanding of technical surveillance measures, like satellite imagery, increased, they developed sophisticated concealment strategies to hide their clandestine nuclear activities (Hansen 2011: 11).

Fifth, the little information that can be acquired through nuclear espionage may not be reliable because proliferating states often attempt to deceive the outside world about their intentions (Ellis and Kiefer 2004: 87–108; Kay 1995). In addition to deception by the target, Western intelligence analysts might be fed false or biased information by liaison intelligence services that have superior access to human sources in the proliferating country, yet which may have ulterior motives (Hansen 2011: 10).

Given these five challenges, intelligence analysts focusing on nuclear proliferation often face overwhelming constraints that make their job difficult even

under the best of circumstances. As a long-time intelligence officer commented, 'uncertainty in this subject abounds, and prediction is foolhardy' (Paul Pillar, quoted in Graham and Hansen 2009: xv). Nevertheless, as the following section chronicles, the US intelligence community has been tasked with 'mission impossible', and has tried hard to fulfil it: predicting the spread of nuclear weapons.

The history of the future of proliferation: reassessing US intelligence estimates

At the dawn of the nuclear age, US intelligence efforts to predict proliferation targeted the nuclear programmes of just a few states that were considered major enemies, such as Nazi Germany and the Soviet Union (Richelson 2006: 17–104). Only in the late 1950s did these spying efforts expand in scope to include both adversaries and allies. This expansion of the US list of nuclear espionage targets went hand-in-hand with attempts to move beyond estimates of individual nations' nuclear activities and also pay attention to worldwide proliferation trends (Burr 2013).

The global assessments came in two forms: National Intelligence Estimates (NIEs) and studies produced by the Central Intelligence Agency (CIA). As of mid-2018, 12 such US assessments of global proliferation trends, each of which typically spans some 20 pages, have been declassified. The first of these estimates was produced in 1957; the most recent declassified appraisal is from 1991. Taken together, the available assessments provide a clearer picture of how the US intelligence community saw the future of proliferation in the early and middle Cold War than in the late Cold War. Two of the 12 estimates were produced in the 1950s (NIE 1957; NIE 1958), five in the 1960s (NIE 1960; NIE 1961; NIE 1963; NIE 1964; NIE 1966), and three in the first half of the 1970s (NIE 1974; NIE 1975; CIA 1975). For the 15-year period from 1976 to 1991, a mere two appraisals of proliferation trends (NIE 1982; NIE 1991) have been declassified, albeit we do not know how many were actually written.

To gauge the performance of US intelligence in forecasting the spread of nuclear weapons, I have compared the time-bounded predictions of states' proliferation behaviour that were made in the intelligence estimates with the current scholarship's understanding (Bleek 2017, unless noted otherwise) of these nations' nuclear status in the years following the assessments. Importantly, only falsifiable statements – that a state 'will' build nuclear weapons, 'is likely to' do so, or that proliferation 'is probable' – were considered predictions. Judgements using strong estimative qualifiers – that a country 'might' or 'could' acquire the bomb, or that proliferation was 'possible' – did not qualify. Predictions relying on scenarios that failed to materialize were also not included in the analysis. Crucially, rather than merging the predictions from all NIEs and CIA studies into a single data set, I reviewed each document individually.

On balance, the 12 declassified US proliferation assessments paint a fairly bleak picture of the future nuclear landscape. In hindsight, 8 of the 12 assessments

strongly overestimated the number of states that would pursue or acquire nuclear weapons within the estimate's timeframe (normally ten years, sometimes five). Three NIEs slightly underestimated the rate of proliferation. In one appraisal, there was no net misestimation in either direction. Not a single assessment predicted all nuclear programmes correctly.

Interestingly, while the overall propensity to overestimate seems clear, this characteristic of US proliferation assessments was not evenly distributed over time. While the early US estimates produced during the 1950s clearly overpredicted the scope of nuclear proliferation over the next decade, US nuclear intelligence during the 1960s appears more accurate in retrospect. In fact, three of the five NIEs produced during this decade slightly *underestimated* the future rate of proliferation. Beginning in the mid-1970s, however, US intelligence returned to its earlier alarmist tone, consistently overpredicting the spread of nuclear weapons.

The identified tendency toward overpredicting the spread of nuclear weapons dovetails nicely with other research that evaluated the forecasting performance of US intelligence agencies based on different measures and further data. Thus, a recent study that focused on country-specific intelligence estimates, as opposed to global trends (Montgomery and Mount 2014), and a survey of both US government and expert assessments (Yusuf 2009) each concluded that when it comes to predicting proliferation, overestimation is the rule and not the exception. Other influential scholarship has echoed this finding (Mueller 2010: 89–95; Gavin 2010: 17–19). However, focusing both on predicting the future and on tracking past and current nuclear activities, one recent study (Bollfrass 2017) found a much higher success rate for US assessments of worldwide proliferation.

Critics may argue that pessimistic forecasts constitute a self-defeating prophecy in that dire predictions spur determined US nonproliferation efforts that prevent more states from going nuclear, thus making the predictions appear alarmist in hindsight although they were justified at the time (Miller 2014). However, after controlling for this potential effect, my results for all the NIEs remain the same. I still find that most of the time, US intelligence overpredicted the spread of nuclear weapons. But *how* did the analysts arrive at their overestimates?

The anatomy of alarmism: how US intelligence overestimates proliferation

From the outside, it is almost impossible to know how US intelligence officers reach a specific judgement that is included in an NIE. While analysts at the working level are required to clarify the reasoning behind their conclusions (Fingar 2010: 80–8), most of this analytically important information is excluded from the version for the intelligence consumers – and this is usually the only document that is declassified. Consequently, researchers seeking to understand certain judgements in NIEs do not know what different pieces of

data the analysts had at their disposal, what assumptions and analogies they used to bridge information gaps, what theories they employed to weigh the evidence, what alternative hypotheses they rejected, and what comparisons they conducted before they qualified their judgements. These specifics of intelligence officers' analytical tradecraft remain hidden from public view, and very few of the (rare) internal reviews that reveal them have been declassified.

Given this fundamental lack of transparency, outsiders can only theorize – rather than describe and explain – how intelligence agencies reach their judgements on a specific issue. Subsequently, one can only examine if the limited available evidence fits the proposed argument. Therefore, in this section I offer such a theory to account for the US intelligence community's overprediction of proliferation.

A capability-based theory of proliferation alarmism

To account for the observed overprediction, the theory proposed here argues that when US intelligence agencies estimated states' future proliferation behaviour, they placed too much emphasis on nations' technological capabilities. While technology is essential for proliferation, an excessive focus on such factors leads analysts to overestimate foreign nuclear programmes. This happens through two mechanisms. First, inferring future nuclear behaviour from capability alone ignores proliferation intent and resolve, thus inflating the number of countries seeking a nuclear arsenal (Hymans 2006; Narang 2016/17). Second, concentrating on facilities and equipment neglects the veritable challenge of successfully running a nuclear weapons *programme* (which is more than the sum of its parts), thereby unduly compressing proliferation timelines (Hymans 2012; Sagan 2010).

Interestingly, the US intelligence community itself apparently tried to avoid relying too much on technological factors in its appraisals of states' future proliferation behaviour. This motivation manifested itself in two ways: First, all assessments explicitly distinguished between nations' 'capabilities' in the nuclear realm, which the NIEs reported first, and the 'probable courses of action' of these states, which were estimated in a subsequent section (e.g. NIE 1957: 2, 5).

Second, in addition to differentiating between capability and intent, US intelligence estimates from 1960 on have stressed at the outset that a state's decision to develop a nuclear arsenal would reflect a calculation of 'a complex of economic, political, military, and psychological considerations' that would differ in each case (NIE 1960: 4). By conceding the importance of those factors that shape a country's willingness and determination to pursue or renounce the bomb, the analysts again seem to have sought to ensure that their predictions would not be dominated by appraisals of technical capabilities, but would pay serious attention to the demand-side variables that strongly influence whether states go or not go nuclear.

Importantly, the theory developed here argues that US intelligence analysts frequently placed an excessive focus on the technical side of the proliferation

equation *despite* the agencies' obvious motivation to produce balanced assessments. Specifically, the theory contends that the unwarranted reliance on capabilities typically resulted from a lack of good evidence on the target state's intentions and resolve to obtain a nuclear arsenal. Without reliable evidence on whether a government actually wanted the bomb, and what political price it was willing to pay to get it, intelligence officers fell back on what they had, using the available information about that state's facilities and technological prowess *as a proxy for intent*. Such inferences, however, blur the analytical distinction between the two domains. On the other hand, when US intelligence possessed credible evidence on proliferation intent, it placed greater inferential weight on this information than on what a state could do given its capabilities. As a result, overestimates became less likely.

Overall trends: abundant supply, few disincentives

In the estimates, the capabilities-centric bias of US nuclear intelligence manifested itself in two ways. One of them concerned the detailed survey of overall supply-side trends that each of the NIEs opened with before looking at individual nations. The usual thrust of this section was that the technologies, materials, and know-how required to develop nuclear weapons were becoming available to ever more states, and that the economic costs of building a small arsenal continued to decrease. Importantly, this section often set the tone for the rest of the estimate. For example, the pessimistic 1958 NIE opened with the gloomy finding that 'a large number' of states 'could produce at least a few' crude nuclear bombs within the next decade (NIE 1958: 1). Since the advent of gas centrifuge technology, which is easier to conceal than other methods of producing fissile material for weapons, the capabilities-centric introduction also included a caution that 'nations could develop nuclear weapons clandestinely, right up to the time of the first test' (NIE 1964: 5). Because such deception would further diminish the chances that intelligence could provide effective warning, this caveat gave the impression that the 'true' proliferation picture was even bleaker than the NIEs suggested.

In contrast, the NIEs' corresponding survey of overall demand-side aspects, and particularly the part on disincentives to acquiring the bomb, was always much shorter and less substantive. Beyond shallow references to the high economic costs of large and sophisticated nuclear forces (as opposed to small arsenals) and the risk of public opposition, the typical thrust of this analysis was that 'it's complicated' and, therefore, the demand-side calculation would differ in each case. Remarkably, US intelligence did not amend the NIEs' list of structural disincentives even after the 1968 Nuclear Nonproliferation Treaty (NPT) had legally banned the development of nuclear arms by additional states and the Nuclear Suppliers Group (NSG) guidelines of 1975 had stigmatized trade in weapons-sensitive technologies, thus transforming the context of future proliferation decision-making.

Written by an outside observer, the analysis above can merely suggest a mismatch between US intelligence's grasp of supply-side trends and demand-side

dynamics. This interpretation receives powerful confirmation, however, through an inside assessment by the US National Intelligence Council (NIC), a high-level panel that must approve all NIEs. Reexamining in 1985 why the recent NIEs had arrived at such massive overestimates of proliferation, the NIC concluded that the appraisals had been 'based on too narrow a perception of the process by which the spread of a nuclear explosive capability comes about'. In particular, while the NIEs generally conceded the key role of demand-side factors, according to the NIC review,

> […] the analysts found it extremely difficult to specify what those nontechnical factors were and how they would affect nuclear decision-making. Consequently, their predictions tended to be driven by straight-line projections of such matters as how soon a country could produce sufficient fissile material for an explosion, given its recent pace of technological acquisition. These projections gave an air of technological inevitability to the proliferation process, implying that, if a country acquired more and more of the technical ingredients that go into making a nuclear device, the decision to consummate that option would become increasingly easier to make and, in fact, would eventually be made.
>
> (NIC 1985: 9)

To sum up, as US analysts struggled to understand demand-side dynamics, they focused on capability, effectively using it as a proxy for proliferation intent.

Country-specific estimates: uncertainty privileges capability

Beyond the global trends section, the emphasis on capabilities was also apparent in the NIEs' analysis of specific countries of proliferation concern. While the NIEs – at least until 1975 (see below) – addressed both a state's capability and proliferation intent, it seems that judgements about the latter were rarely informed by high-quality intelligence, such as insights from credible human sources. Rather, the officers had to rely on open sources and their own abstract beliefs about how the (nuclear) world works, to infer a state's willingness to develop the bomb. Facing such uncertainty, US analysts again let 'hard facts' about capabilities drive their predictions.

The 1950s

An internal review of the 1958 NIE – which, in retrospect, had strongly overpredicted proliferation – is fully in line with this interpretation. It complained that, 'With respect to the *political factors* in the possible decisions of fourth countries to initiate nuclear weapons programs, we believe that the field reporting could be more full than it now is' (US Intelligence Board 1958: 2, italics in the original). In other words, when they were producing an NIE that massively overestimated future proliferation, US analysts had lacked the raw data necessary to

make informed judgements about nations' intent and resolve to obtain nuclear weapons.

The 1960s

In response to the 1958 reappraisal, the State Department requested concerned diplomatic missions to step up their intelligence collection and reporting on the 'political aspects' shaping the demand-side of nuclear choices (Department of State 1958). Fortunately for US spies, among the states of proliferation concern in the 1950s and 1960s, most were Western industrialized nations and US allies. The large American presence in these countries and the dense web of personal relationships naturally facilitated US intelligence collection, notably from human sources. Perhaps as a result, judgements about the nuclear intentions of these Western targets improved markedly in the 1960s, and overestimates of their future proliferation behaviour almost disappeared *despite the continued build-up of their capability to develop the bomb*. For instance, unlike previous estimates, the 1960 NIE confidently reported about West Germany and Sweden's intentions that neither of the two governments had plans to develop nuclear weapons and that both were therefore unlikely to do so (NIE 1960). Their technical ability to build an arsenal ceased to be the dominant indicator.

Consistent with this pattern of reduced uncertainty about Western nuclear ambitions, the one state whose programme was repeatedly overestimated during the 1960s – India – was a non-Western developing country that US spies found hard to penetrate. While Washington was well informed about India's advanced nuclear facilities, the same was not true for India's lacking intent to deploy an arsenal. Yet although they knew almost nothing about Indian leaders' proliferation calculus, the authors of the 1964 and 1966 NIEs still predicted that the country would soon build the bomb. Tellingly, to support this conclusion, neither estimate pointed to any *actual* tectonic shifts in Delhi. Both just referred to 'internal pressures' that 'will probably rise' over the coming years and then somehow push India over the weapons threshold (NIE 1964: 8). While confirmation is elusive, the fact that, technically, India was merely 'a screwdriver's turn' away from the bomb apparently made US analysts bet that leaders in Delhi would *soon* want nuclear weapons, although they had zero evidence of such intentions.

The 1970s and after

Given *how* US intelligence had overestimated India in the 1960s, regional trends in subsequent decades promised to make the task of predicting proliferation even more daunting. Since the 1970s, the countries ending up on Washington's list of states of proliferation concern were overwhelmingly developing states in the Middle East, Asia, and Latin America. Collecting intelligence, notably from human sources, was more challenging in these countries as the United States

typically had no troops there, nor close political ties to the regimes. With only a rudimentary grasp of their targets' nuclear intentions, US analysts again seemed to rely too heavily on technical indicators to predict behaviour.

This verdict applies, for instance, to the estimate on Taiwan in 1974, although the latter was then still a US treaty ally. Even as US analysts had 'no reliable information' about Taiwan's nuclear plans, they still asserted that it would 'probably' build the bomb by the mid-1980s (NIE 1974: 28–9). The logic behind this prediction likely included the technological determinism that is reflected in the NIE's account of Taiwan's proliferation motives until 1974. According to that appraisal, 'most likely […] the program gathered momentum as the military-scientific bureaucracy expanded to staff the effort, and feasibility became an independent justification of sorts' (NIE 1974: 28). Hence, US intelligence believed that, at least to some extent, growing capability had been driving Taipei's willingness to proliferate. Absent reliable evidence on intent, this assumption about the influence of technical progress may have shaped the US prediction of Taiwan's future trajectory as well.

Notably, the US intelligence establishment knew that its technology-centric nuclear expertise presented a problem. In 1976, a review by intelligence community staff concluded that only its grasp of the technical aspects of proliferation was 'satisfactory', and that an improved overall performance required analysts to achieve 'greater political, economic, and military integration with the technical aspects' (CIA 1977: 9). Rather than paying more attention to such demand-side factors, however, the NIEs produced after 1974 *doubled down* on states' capabilities. Specifically, the definition across the estimates of what constitutes nuclear proliferation began to shift, a change that was later criticized by the intelligence establishment because it was never clearly stated in the assessments (NIC 1985: 7). Thus, while the 1974 estimate, like all previous NIEs, had studied who would acquire a nuclear *weapon* capability, the update produced the following year broadened the scope. It was explicitly written to provide the earliest dates for when countries could build a nuclear *explosive* device, as India had done in 1974 – a step well below the important weaponization threshold (NIE 1975: 1). Expanding the definition of proliferation even further, the 1982 NIE concentrated on the spread of *sensitive nuclear facilities* that states might use to develop a nuclear explosive (or weapons) capability, but which do not individually represent that more disturbing capability.

Absent an explanation for why a broader definition was appropriate, and what it meant for the predictions made prior to 1975, the shifting understanding of proliferation raised grave questions about the comparability of results across time. (To facilitate such comparability, this chapter has considered only those predictions in NIEs that included an expectation of nuclear *weapons* intent.) More important for the inferences made by US intelligence, however, the broadened definition further incentivized the development of technical competence at the expense of expertise on demand-side aspects. The task of predicting which countries will build sensitive facilities – without having to estimate if they will use the facilities for weapons purposes – can be fulfilled by simply monitoring

the technical progress of their civilian nuclear research programmes. Reading these states' intentions is not necessary to this end. As a result, engaging in the difficult business of discerning nuclear intentions became even less attractive for intelligence officers. In fact, from the analysts' viewpoint, the increased emphasis on technical aspects made the job of forecasting proliferation more straightforward: Hidden in the text of one NIE, they conceded that 'the evolution of nuclear capabilities' was easy to predict because it '[c]an be estimated fairly well and is not susceptible to rapid fluctuations' (NIE 1982: 14).

Even as nuclear *weapons* proliferation ceased to be the principal focus of US estimates after 1974, the agencies continued to offer some judgements on such ambitions. Reflecting the growing neglect of political analysis, US intelligence's detailed picture of a state's nuclear facilities and equipment then sometimes appeared to make the analysts overconfident as to what that state's proliferation intentions *must* be. The judgement made in 1982 that Argentina was constructing a facility that 'is useful, in practical terms, only for manufacturing [nuclear] explosive devices', when in fact that nation never sought such explosives, is a case in point (NIE 1982: 21). As far as the analysts were concerned, however, drawing on capability to infer intent and predict proliferation behaviour was good enough since tracking nuclear facilities 'offers insights into past policy decisions, [which are] sometimes the only reliable evidence concerning current policies' (NIE 1982: 14).

None of the above is to suggest that the intelligence officials responsible for the US assessments did not do reasonably well in predicting the nuclear future. It is clearly part of the job of intelligence analysts to bridge information gaps through analogies and assumptions about unknowns, including other governments' intentions and their determination to achieve specific goals (Fingar 2010: 72). The point made here is just that US analysts consistently erred toward overestimation because they privileged one specific indicator: states' capability to build the bomb. This inquiry into the mechanisms of US overestimation is of more than academic interest because, as the following section illustrates, overpredicting global proliferation can have lasting real-world consequences.

The consequences of alarmism: the nonproliferation regime as we know it

The envisioned future of increasing proliferation was a key driver for the creation and the subsequent strengthening of today's global nuclear order. Specifically, pessimistic forecasts that nuclear weapons were about to spread to ever more states played a crucial role in the tightening of US nuclear nonproliferation policy in the mid-1960s and the mid-1970s (Miller 2018). Importantly, these strengthened US policies were instrumental in building two central pillars of the international nonproliferation regime: the NPT and the NSG. However, although the predictions triggering these efforts originated in the US government, it was expert panels and agencies outside the intelligence community who produced these estimates.

The Gilpatric Report and the road to the NPT

The changes to US policy made in the mid-1960s concerned the universal application of strict nonproliferation standards to both adversaries and allies of the United States (Gavin 2004/05). Though containing proliferation has been a consistent goal of US policy throughout the nuclear age (Gavin 2015), until 1965 Washington had not always accorded nonproliferation a high priority in relations with friendly regimes (Trachtenberg 1999). This selective enforcement was abandoned in response to alarming predictions that the spread of nuclear weapons was about to accelerate. Specifically, several US studies anticipated that Communist China's first nuclear weapon test in October 1964 would trigger nuclear domino effects. In this view, proliferation in response to China by nations friendly to the United States, such as Japan and India, would lead even more, and potentially adversarial, countries, to embark upon the path toward a nuclear arsenal (Miller 2018).

One such warning was issued by the US Arms Control and Disarmament Agency (FRUS 1964–1968a). The greatest impact on subsequent US policy, though, was a 1965 report produced for President Lyndon Johnson by a blue-ribbon panel chaired by former Deputy Secretary of Defense Roswell Gilpatric. In their report, the members of this Gilpatric Committee ominously predicted that once India and Japan would react to Chinese proliferation with their own bomb projects, 'we do not believe that the spread of nuclear weapons would or could be stopped there'. In the end, Egypt, Israel, Pakistan, West Germany, and several others would surely follow suit to join the nuclear weapons club (FRUS 1964–1968b: 174).

In hindsight, this projection seems excessively pessimistic. Whether it was realistic or not, however, the Gilpatric Committee Report apparently had a decisive influence on official US nonproliferation policy. Embracing the report's appraisal of imminent danger, President Johnson, after some delay, authorized a comprehensive programme that intensified US efforts to combat proliferation across-the board, and which reflected the basic gist of the Gilpatric Committee's recommendations (Brands 2006). Chief among these initiatives was the decision to give priority to reaching a broad nonproliferation agreement with the Soviet Union, even if this meant burying the idea of joint nuclear forces that some European allies were then strongly interested in – a sharp departure from previous US policy that eventually led to the NPT (Brands 2007; Popp 2017).

Interestingly, the Gilpatric Report's influential premise, that many countries would soon acquire a nuclear arsenal if US policies remained unchanged, was strongly at odds with the intelligence community's views at the time. The 1964 NIE, which was completed days after China's first nuclear test, only slightly overpredicted global proliferation. Its authors expected, erroneously, that India would soon weaponize its nuclear programme but did not feel comfortable making any other unequivocal predictions of proliferation decisions (NIE 1964). Moreover, a briefing paper that the CIA prepared *for the Gilpatric Committee's deliberations* also predicted a fairly benign future nuclear landscape, going even

further than the NIE by judging that 'Israel probably has decided not to build nuclear weapons' (CIA 1964: 10). US intelligence thus painted a picture of global nuclear trends that was not nearly as dark as the Gilpatric Report's vision of impending proliferation doom. The fact that both the committee and US policy-makers ignored these intelligence judgements gives rise to important questions, such as Who gets heard, and Which prediction is acted upon. Unfortunately, however, the reasons why the intelligence community failed to have an impact on US policy in this particular case are not known.

The Under Secretaries' Report, the Lord Paper, and the NSG

In the mid-1970s, US nonproliferation policy was strengthened further as a result of several major advances (Miller 2018: 74–90). Among these initiatives, however, only the Ford administration's push for the NSG can be directly linked to predictions of proliferation. Specifically, two studies produced in reaction to India's first nuclear test in May 1974 offered a gloomy picture of the event's impact on the further spread of nuclear arms.

The first estimate ringing the alarm bell was a draft paper on US nonproliferation policy prepared in June 1974 by the National Security Council's Under Secretaries Committee. The study estimated that the consequence of the Indian nuclear test 'could be a sequential or "chain reaction" with perhaps as many as ten additional states acquiring some nuclear weapons capability' (FRUS 1969–1976a: 132). The State Department's director of policy planning, Winston Lord, produced another paper for Secretary Henry Kissinger. Like the Under Secretaries' Report, the Lord Paper worried that India's test 'could lead others to acquire independent nuclear explosives capabilities in a "chain reaction" effect' (Department of State 1974: 1). Notably, although both studies argued only that India's test *could* trigger domino effects, and thus did not explicitly predict further proliferation, US policy-makers evidently understood the phrasings as firm predictions. In meetings, Lord asserted that concerning proliferation, 'if we don't do anything, certainly the situation is going to get much worse, and the pace will pick up, and the spread will be all but inevitable'. Even firmer in his view, Kissinger projected that no matter what Washington did, additional proliferation was 'probably inevitable' (FRUS 1969–1976b: 193).

Like the Gilpatric Report's predictions, the estimates from the 1970s – that over the next years, proliferation would be 'much worse' than before and involve 'as many as ten additional states' – appear exaggerated in hindsight. Nevertheless, they apparently shaped US nonproliferation policy to a significant degree (Miller 2018: 75–9). Buying into the Under Secretaries' Report and the Lord Paper's nuclear domino scenarios, US policy-makers embraced the reports' recommendation to curb further proliferation by seeking consultations among the major supplier states on common rules that ensure that nuclear exports would not contribute to nuclear weapons programmes. Out of this 1974 US initiative grew intense secret negotiations among seven advanced nuclear industrial powers that quickly led to what later became known as the NSG (Burr 2014).

Interestingly, unlike in the previous decade, in the mid-1970s the influential government studies on proliferation were in line with how US intelligence viewed the future spread of nuclear arsenals. The authors of the 1974 NIE, which was completed in December 1974, were just as concerned as Winston Lord and the members of the Under Secretaries' Committee, expecting that several more states would soon develop a nuclear arsenal (NIE 1974). It is not clear, however, to what extent the authors of the two papers had consulted with US intelligence for their projections.

Instead of a conclusion: putting US overprediction into perspective

Drawing on the declassified record of global proliferation assessments, this chapter has found that the US intelligence community has never been fully correct in predicting the spread of nuclear weapons, and it has typically erred in the direction of overestimation. This finding needs to be put into perspective. Most obviously, it bears repeating that owing to the dual-use nature of nuclear technology and the secretive character of nuclear politics, intelligence analysts working on proliferation are being asked to make predictions against an exceptionally hard target.

Moreover, and relatedly, intelligence analysts are fully aware of the perils of predicting others' behaviour under great uncertainty. Unfortunately, though, the intelligence community's principal customers – policy-makers – favour appraisals exhibiting certainty, not cautious and conditional estimates. Therefore, while intelligence officers prefer qualifying language and loathe making firm predictions, the desire to provide analyses that policy-makers find useful naturally pushes intelligence analysts toward stripping their judgements of indications of doubt and making unequivocal predictive claims (Rovner 2010: 12, 24). In this setting, it is not surprising that intelligence analysts attempted to predict the future nuclear landscape, nor that their predictions repeatedly turned out to be wrong.

Finally, the fact that gloomy projections have twice spurred US initiatives that bolstered international nonproliferation efforts does not imply that alarmist proliferation estimates will always have such positive effects. The flawed US intelligence on Iraq's weapons of mass destruction, and the key role it played on the road to the 2003 war (Jervis 2006), is a forceful reminder that exaggerated proliferation estimates may come at a very high price. No less important, however, it is policy-makers, not intelligence analysts, who bear ultimate responsibility for nonproliferation policy in general and decisions for war in particular: NIEs do *not* force the policy-maker's hand when the latter responds to a threat assessment.

Note

1 The author would like to thank Alex Bollfrass, Myriam Dunn Cavelty, Liviu Horovitz, Ulla Jasper, Oliver Meier, Oliver Thränert, and Andreas Wenger for helpful comments.

References

Abraham, I. (1999) *The Making of the Indian Atomic Bomb: Science, Secrecy, and the Postcolonial State*, London: Zed Books.

Acton, J. M. (2009) 'The Problem with Nuclear Mind Reading', *Survival* 51(1): 119–42.

Bell, M. S. (2015) 'Beyond Emboldenment: How Acquiring Nuclear Weapons Can Change Foreign Policy', *International Security* 40(1): 87–119.

Bell, M. S. (2016) 'Examining Explanations for Nuclear Proliferation', *International Studies Quarterly* 60(3): 520–9.

Bleek, P. C. (2017) *When Did (and Didn't) States Proliferate? Chronicling the Spread of Nuclear Weapons*, Cambridge, MA: Harvard Kennedy School/Monterey, CA: James Martin Center for Nonproliferation Studies.

Bollfrass, A. K. (2017) *The Half-Lives of Others: Explaining the Accuracy of Nuclear Proliferation Assessments*, Doctorate thesis, Princeton University.

Brands, H. (2006) 'Rethinking Nonproliferation: LBJ, the Gilpatric Committee, and US National Security Policy', *Journal of Cold War Studies* 8(2): 83–113.

Brands, H. (2007) 'Nonproliferation and the Dynamics of the Middle Cold War: The Superpowers, the MLF, and the NPT', *Cold War History* 7(3): 389–423.

Burr, W. (2005) 'National Intelligence Estimates of the Nuclear Proliferation Problem: The First Ten Years, 1957–1967', *National Security Archive Electronic Briefing Book No. 155*. Online. Available: https://nsarchive2.gwu.edu//NSAEBB/NSAEBB155/index.htm (accessed 7 March 2019).

Burr, W. (2013) 'Nuclear Proliferation Intelligence, 1966–1991: China May Have Helped Pakistan Nuclear Weapons Design, Newly Declassified Intelligence Indicates', *National Security Archive Electronic Briefing Book No. 423*. Online. Available: https://nsarchive2.gwu.edu/nukevault/ebb423 (accessed 7 March 2019).

Burr, W. (2014) 'A Scheme of "Control": The United States and the Origins of the Nuclear Suppliers Group, 1974–1976', *International History Review* 36(2): 252–76.

Chernoff, F. C. (2014) *Explanation and Progress in Security Studies: Bridging Theoretical Divides in International Relations*, Stanford, CA: Stanford University Press.

CIA (1964) 'Memorandum: Nuclear Weapons Programs around the World', *National Security Archive Electronic Briefing Book No. 155*. Online. Available: https://nsarchive2.gwu.edu//NSAEBB/NSAEBB155/prolif-10.pdf (accessed 7 March 2019).

CIA (1975) 'Managing Nuclear Proliferation: The Politics of Limited Choice', Central Intelligence Agency Research Study OPR 408, *National Security Archive Electronic Briefing Book No. 155*. Online. Available: https://nsarchive2.gwu.edu//NSAEBB/NSAEBB155/prolif-15.pdf (accessed 7 March 2019).

CIA (1977) 'A Review of Nuclear Proliferation Intelligence Activities and Developments', DCI/IC 77–2500, *CIA Electronic Reading Room*. Online. Available: www.cia.gov/library/readingroom/docs/CIA-RDP83M00171R000500150006-1.pdf (accessed 7 March 2019).

Cohen, A. and Frankel, B. (1990) 'Opaque Nuclear Proliferation', *Journal of Strategic Studies* 13(3): 14–44.

Debs, A. and Monteiro, N. P. (2017) 'Conflict and Cooperation on Nuclear Nonproliferation', *Annual Reviews of Political Science* 20: 331–49.

Department of State (1958) 'Development of Nuclear Weapons Capabilities by "Fourth Powers": Political Aspects, December 3, 1958', *National Security Archive Electronic Briefing Book No. 155*. Online. Available: https://nsarchive2.gwu.edu//NSAEBB/NSAEBB155/prolif-4c.pdf (accessed 7 March 2019).

Department of State (1974) 'Discussion Paper on US Nonproliferation Policy, Enclosed with Briefing Memorandum to Secretary of State Kissinger from Policy Planning Staff Director Winston Lord, "Analytical Staff Meeting", July 11, 1974', *National Security Archive Electronic Briefing Book No. 467*. Online. Available: https://nsarchive2.gwu.edu/nukevault/ebb467/docs/doc%205%207–11–74%20discussion%20paper%20for%20staff%20meeting.pdf (accessed 7 March 2019).

ElBaradei, M. (2004) *Statement to the Forty-Eighth Regular Session of the IAEA General Conference 2004*, International Atomic Energy Agency (IAEA), 20 September. Online. Available: www.iaea.org/newscenter/statements/statement-forty-eighth-regular-session-iaea-general-conference-2004 (accessed 7 March 2019).

Ellis, J. D. and Kiefer, G. D. (2004) *Combating Proliferation: Strategic Intelligence and Security Policy*, Baltimore, MD: Johns Hopkins University Press.

Fingar, T. (2010) *Reducing Uncertainty: Intelligence Analysis and National Security*, Stanford, CA: Stanford University Press.

Fitzpatrick, M. (2016) *Asia's Latent Nuclear Powers: Japan, South Korea, and Taiwan*, New York: Routledge.

FRUS (1964–1968a) 'Draft Position Paper, August 14, 1964', in E. Gerakas, D. S. Patterson and C. B. Yee (eds) *Foreign Relations of the United States, 1964–1968, Volume XI: Arms Control and Disarmament*, Washington, DC: US Government Printing Office, 97–110.

FRUS (1964–1968b) 'Report by the Committee on Nuclear Proliferation, January 21, 1965', in E. Gerakas, D. S. Patterson and C. B. Yee (eds) *Foreign Relations of the United States, 1964–1968, Volume XI: Arms Control and Disarmament*, Washington, DC: US Government Printing Office, 173–82.

FRUS (1969–1976a) 'Paper Prepared by the NSC Under Secretaries Committee, June 21, 1974', in K. L. Ahlberg, B. S. Kim and C. Tudda (eds) *Foreign Relations of the United States, 1969–1976, Volume E-14, Part 2: Documents on Arms Control and Nonproliferation, 1973–1976*, Washington, DC: US Government Printing Office, 129–44.

FRUS (1969–1976b) 'Minutes of Secretary of State Kissinger's Analytical Staff Meeting, July 12, 1974', in K. L. Ahlberg, B. S. Kim and C. Tudda (eds) *Foreign Relations of the United States, 1969–1976, Volume E-14, Part 2: Documents on Arms Control and Nonproliferation, 1973–1976*, Washington, DC: US Government Printing Office, 191–207.

Fuhrmann, M. and Tkach, B. (2015) 'Almost Nuclear: Introducing the Nuclear Latency Dataset', *Conflict Management and Peace Science* 32(4): 443–61.

Gavin, F. J. (2004/05) 'Blasts from the Past: Proliferation Lessons from the 1960s', *International Security* 29(3): 100–35.

Gavin, F. J. (2010) 'Same as It Ever Was: Nuclear Alarmism, Proliferation, and the Cold War', *International Security* 34(3): 7–37.

Gavin, F. J. (2015) 'Strategies of Inhibition: US Grand Strategy, the Nuclear Revolution, and Nonproliferation', *International Security* 40(1): 9–46.

Graham, T. Jr. and Hansen, K. A. (2009) *Preventing Catastrophe: The Use and Misuse of Intelligence in Efforts to Halt the Proliferation of Weapons of Mass Destruction*, Stanford, CA: Stanford University Press.

Hansen, K. A. (2011) *Intelligence and Nuclear Proliferation: Lessons Learned*, Proliferation Papers No. 38, Paris: IFRI.

Hymans, J. E. C. (2006) *The Psychology of Nuclear Proliferation: Identity, Emotions, and Foreign Policy*, New York: Cambridge University Press.

Hymans, J. E. C. (2012) *Achieving Nuclear Ambitions: Scientists, Politicians, and Nuclear Proliferation*, New York: Cambridge University Press.

Jervis, R. (2006) 'Reports, Politics, and Intelligence Failures: The Case of Iraq', *Journal of Strategic Studies* 29(1): 3–52.

Kay, D. A. (1995) 'Denial and Deception Practices of WMD Proliferators: Iraq and Beyond', *Washington Quarterly* 18(1): 85–105.

Lewis, J. (2015) 'Sorry, Fareed: Saudi Arabia Can Build a Bomb Any Damn Time It Wants to', *Foreign Policy*, 12 June. Online. Available: http://foreignpolicy.com/2015/06/12/sorry-fareed-saudi-arabia-can-build-a-bomb-any-damn-time-it-wants-to (accessed 7 March 2019).

Maddock, S. J. (2010) *Nuclear Apartheid: The Quest for American Nuclear Superiority from World War II to the Present*, Chapel Hill, NC: University of North Carolina Press.

Mikoyan, S. (2012) *The Soviet Cuban Missile Crisis: Castro, Mikoyan, Kennedy, Khrushchev, and the Missiles of November*, ed. by Svetlana Savranskaya, Washington, DC: Woodrow Wilson Center Press.

Miller, N. L. (2014) 'Nuclear Dominoes: A Self-Defeating Prophecy?', *Security Studies* 23(1): 33–73.

Miller, N. L. (2018) *Stopping the Bomb: The Sources and Effectiveness of US Nonproliferation Policy*, Ithaca, NY: Cornell University Press.

Montgomery, A. H. and Mount, A. (2014) 'Misestimation: Explaining US Failures to Predict Nuclear Weapons Programs', *Intelligence and National Security* 29(3): 357–86.

Mueller, J. (2010) *Atomic Obsession: Nuclear Alarmism from Hiroshima to Al-Qaeda*, New York: Oxford University Press.

Müller, H. and Schmidt, A. (2010) 'The Little-Known Story of Deproliferation: Why States Give Up Nuclear Weapons Activities', in W. C. Potter and G. Mukhatzhanova (eds) *Forecasting Nuclear Proliferation in the 21st Century 1: The Role of Theory*, Stanford, CA: Stanford University Press, 124–58.

Narang, V. (2016/17) 'Strategies of Nuclear Proliferation: How States Pursue the Bomb', *International Security* 41(3): 110–50.

NIC (National Intelligence Council) (1985) 'The Dynamics of Nuclear Proliferation: Balance of Incentives and Constraints', NIC Memorandum 85–10001, *National Security Archive Electronic Briefing Book No. 451*. Online. Available: https://nsarchive2.gwu.edu/nukevault/ebb451/docs/8.pdf (accessed 7 March 2019).

NIE (1957) 'Nuclear Weapons Production in Fourth Countries: Likelihood and Consequences', National Intelligence Estimate 100–6-57, *National Security Archive Electronic Briefing Book No. 155*. Online. Available: https://nsarchive2.gwu.edu//NSAEBB/NSAEBB155/prolif-2.pdf (accessed 7 March 2019).

NIE (1958) 'Development of Nuclear Capabilities by Fourth Countries: Likelihood and Consequences', National Intelligence Estimate 100–2-58, *National Security Archive Electronic Briefing Book No. 155*. Online. Available: https://nsarchive2.gwu.edu//NSAEBB/NSAEBB155/prolif-3a.pdf (accessed 7 March 2019).

NIE (1960) 'Likelihood and Consequences of the Development of Nuclear Capabilities by Additional Countries', National Intelligence Estimate 100–4-60, *National Security Archive Electronic Briefing Book No. 155*. Online. Available: https://nsarchive2.gwu.edu//NSAEBB/NSAEBB155/prolif-5.pdf (accessed 7 March 2019).

NIE (1961) 'Nuclear Weapons and Delivery Capabilities of Free World Countries Other than the US and UK', National Intelligence Estimate 4–3-61, *National Security*

Archive Electronic Briefing Book No. 155. Online. Available: https://nsarchive2.gwu.edu//NSAEBB/NSAEBB155/prolif-6b.pdf (accessed 7 March 2019).

NIE (1963) 'Likelihood and Consequences of a Proliferation of Nuclear Weapons Systems', National Intelligence Estimate 4–63, *National Security Archive Electronic Briefing Book No. 155*. Online. Available: https://nsarchive2.gwu.edu//NSAEBB/NSAEBB155/prolif-8.pdf (accessed 7 March 2019).

NIE (1964) 'Prospects for a Proliferation of Nuclear Weapons over the Next Decade', National Intelligence Estimate 4–2-64, *National Security Archive Electronic Briefing Book No. 155*. Online. Available: https://nsarchive2.gwu.edu//NSAEBB/NSAEBB155/prolif-9.pdf (accessed 7 March 2019).

NIE (1966) 'The Likelihood of Further Nuclear Proliferation', National Intelligence Estimate 4–66, *National Security Archive Electronic Briefing Book No. 423*. Online. Available: https://nsarchive2.gwu.edu/nukevault/ebb423/docs/1.%201966%20NIE.pdf (accessed 7 March 2019).

NIE (1974) 'Prospects for Further Proliferation of Nuclear Weapons', Special National Intelligence Estimate 4–1-74, *National Security Archive Electronic Briefing Book No. 240*. Online. Available: https://nsarchive2.gwu.edu/NSAEBB/NSAEBB240/snie.pdf (accessed 7 March 2019).

NIE (1975) 'Memorandum to Holders of Special National Intelligence Estimate 4–1-74: Prospects for Further Proliferation of Nuclear Weapons', *Wilson Center Digital Archive*. Online. Available: http://digitalarchive.wilsoncenter.org/document/121391 (accessed 7 March 2019).

NIE (1982) 'Nuclear Proliferation Trends through 1987', National Intelligence Estimate 4–82, *National Security Archive Electronic Briefing Book No. 423*. Online. Available: https://nsarchive2.gwu.edu/nukevault/ebb423/docs/4.%20%20nuke%20prolif%20trends%20thru%2087.pdf (accessed 7 March 2019).

NIE (1991) 'Prospects for Special Weapons Proliferation and Control', National Intelligence Estimate 5–91, *National Security Archive Electronic Briefing Book No. 423*. Online. Available: https://nsarchive2.gwu.edu/nukevault/ebb423/docs/11.%20special%20weapons.pdf (accessed 7 March 2019).

Popp, R. (2017) 'The Long Road to the NPT: From Superpower Collusion to Global Compromise', in R. Popp, L. Horovitz and A. Wenger (eds) *Negotiating the Nuclear Nonproliferation Treaty: Origins of the Nuclear Order*, London: Routledge, 9–35.

Potter, W. C. and Mukhatzhanova, G. (2008) 'Divining Nuclear Intentions: A Review Essay', *International Security* 33(1): 139–69.

Richelson, J. T. (2006) *Spying on the Bomb: American Nuclear Intelligence from Nazi Germany to Iran and North Korea*, New York: W. W. Norton.

Rovner, J. (2010) *Fixing the Facts: National Security and the Politics of Intelligence*, Ithaca, NY: Cornell University Press.

Sagan, S. D. (1996/97) 'Why do States Build Nuclear Weapons: Three Models in Search of a Bomb', *International Security* 21(3): 54–86.

Sagan, S. D. (2010) 'Nuclear Latency and Nuclear Proliferation', in W. C. Potter and G. Mukhatzhanova (eds) *Forecasting Nuclear Proliferation in the 21st Century 1: The Role of Theory*, Stanford, CA: Stanford University Press, 80–101.

Santoro, D. (2017) *Myanmar: A Nonproliferation Success Story*, Canberra: Australian Strategic Policy Institute.

Trachtenberg, M. (1999) *A Constructed Peace: The Making of the European Settlement, 1945–1963*, Princeton, NJ: Princeton University Press.

US Intelligence Board (1958) 'Post-Mortem on NIE 100–2-58: Development of Nuclear Capabilities by Fourth Countries: Likelihood and Consequences, dated 1 July 1958', *National Security Archive Electronic Briefing Book No. 155*. Online. Available: https://nsarchive2.gwu.edu//NSAEBB/NSAEBB155/prolif-4c.pdf (accessed 7 March 2019).

Yusuf, M. (2009) *Predicting Proliferation: The History of the Future of Nuclear Weapons*, Policy Paper No. 11, Washington, DC: Brookings Institution Press.

13 ‘We do that once per day’

Cyclical futures and institutional ponderousness in predictive policing[1]

Matthias Leese

In recent years, predictive policing has ascended to become a pertinent form of addressing the future in the everyday production of security. Underpinned by the promise of catching a criminal before the crime – or at least to be ‘at the crime scene before the criminal’ (Schweer 2015) – predictive policing seeks to reorganize police work in terms of efficiency and effectiveness through the algorithmic calculation of crime risk. Such risk is usually structured along the dimensions of time and space, so that the presumed occurrence of future crime can be located in specific neighbourhoods and during specific timeframes. Subsequently, so the rationale goes, resources can be reallocated accordingly and preventive efforts can be undertaken, so that the predicted offences will not materialize (e.g. McCue 2007; McCue and Parker 2003; Perry *et al*. 2013). Preventive measures thereby usually consist of a combination of intensified patrols (plain-clothed and/or in uniform), traffic controls, and awareness campaigns in the identified neighbourhoods.

This chapter investigates the precise temporal modalities that emerge in addressing the future through algorithmic analyses of crime data. It argues that there is a considerable rift between the techno-imaginary of seamlessness and continuous flows of live data that result in real-time situational updates and maximum responsiveness on the one hand, and the static ways in which police departments use predictive policing software on the other. Due to the asynchronicity between crime and police work, the police consider it in fact sufficient to analyse crime data only once per day and work with the produced predictions for up to seven days. The daily use of predictive policing software thereby decisively undercuts narratives of real-time analysis and ensuing operational flexibility vis-à-vis a supposedly dynamic threat environment. This practice becomes reinforced and aggravated by limited personnel resources that produce a certain institutional ponderousness when it comes to the street-level enactment of crime prevention measures. Overall, so this chapter puts forward, the temporalities of predictive policing speak closely to the characteristics of the addressed type of crime and to entrenched operational requirements of police work. Predicting the future must in this sense be considered as an iterative, everyday activity that is characterized by a deliberatively short time frame.

Empirical research for this article consisted of multiple ethnographic observations in four German and Swiss police departments that have implemented the software package PRECOBS ('Pre Crime Observation System') by German manufacturer IfmPt,[2] as well as 23 semi-structured expert interviews with involved police officers and software developers, conducted between June 2016 and August 2017. Interview recordings have been transcribed and coded using qualitative data analysis software. All collected material has been anonymized as per agreement with the researched institutions and individuals. Quotations have been translated from German by the author.

The chapter proceeds as follows. First, it provides a brief overview of the distinct empirical approaches to predictive policing, foregrounding the underlying assumptions of prevalent spatio-temporal forms of prediction, and introducing the PRECOBS software package that has been implemented in the researched departments. Working through the empirical material, it then specifies the ways in which predictive policing is practised in everyday police work and analyses the modes in which criminal futures come into being. It concludes by contextualizing everyday predictive policing operations within larger trajectories of prediction and politics, as discussed by the other contributions to this volume.

Predictive policing with PRECOBS

Predictive policing is not one practice, one model, or even one software package (e.g. Bennett Moses and Chan 2016; Kaufmann 2018; Perry *et al*. 2013). Rather, the notion of predictive policing must be understood as a broad label for a variety of ways of bringing criminal futures into being and rendering them actionable. Variance thereby stems from different forms of implementation into everyday police work, as well as from theoretical assumptions, models, and the data that these models are predicated upon. The common denominator of all of them is the managerial aspiration to be able to 'do more with less' (Beck and McCue 2009) through an increase in efficiency and effectiveness. This is supposed to be realized through the underpinning rationale that once an empirically informed prediction of crime-relevant futures has been created, police work on the street level can subsequently be restructured and available resources can be reallocated to areas where crime prevention measures promise to be most successful.

On a more fundamental organizational level, predictive policing in this sense has the capacity to transform the relation that the police build with the future. Unlike earlier manual practices of crime mapping, the promise of predictive policing rests on the combination of digitization, processing power, and the algorithmic exploitation of data. Taken together, these elements present the police with the opportunity to address the future on an unprecedented scale and with unprecedented speed. Criminal futures, at least in theory, are only one mouse-click away, and this novel availability opens up a new set of operational options in terms of actively intervening into these futures as they unfold.

Within the current landscape of predictive policing, two major paradigms can be identified. On the one hand, there are methods that seek to predict *offenders*, thereby creating risk profiles that identify individuals who are more likely to commit crimes or become victims of crime. Such approaches, as for instance used by the Chicago Police Department in its prominent 'strategic subject list' (Saunders *et al*. 2016) have garnered much public attention and critical debate (e.g. Dallke 2017; Gorner 2013; Stanley 2014), as they rely on the collection and combination of data about individuals, possibly including the likes of communication data and social network data. These data are then combined and processed in order to identify individual proximity to crime, for example through algorithmic association rules. Living in a crime-ridden neighbourhood or interaction with known gang members would in this sense serve as indicators that a person could be more likely to either become a victim of crime or an offender, and should thus be targeted through prevention programmes.

The underlying ambition of such wide-ranging data collection and advanced analytics for individualized crime predictions, coupled with a lack of transparency about how risk profiles are in fact calculated, has sparked rather dystopian readings of predictive policing as a form of surveillance and coercion, where state agencies would use an information edge to govern and control populations (e.g. Andrejevic 2017; Hildebrandt 2016; Mantello 2016). Such concerns should not be easily dismissed, as commercial software suppliers and police departments, particularly in the US, are pushing further into this direction. As of today, the majority of regularly implemented predictive policing tools however follow a quite different route into addressing the future. Instead of individuals, they foreground the *place and time* of future criminal activity (Bennett Moses and Chan 2018; Egbert 2017; Gluba 2014; Gluba and Pett 2017; Perry *et al*. 2013).

The most commonly used approach in current predictive policing practices is thereby based on near-repeat modelling. The near-repeat hypothesis rests upon the empirical observation that the best predictor for victimization is in fact victimization itself. In other words, a person or a place that has already experienced crime is more likely to experience further crime than a person or a place that has not (e.g. Farrell 1995; Farrell *et al*. 1995). This observation is particularly pertinent for burglaries, whereby the near-repeat hypothesis presupposes that when within a specific area a burglary has been recorded, there is an increased likelihood for follow-up offences in that area in the following days (e.g. Polvi *et al*. 1991; Townsley *et al*. 2003). Near-repeat models are thereby undergirded by assumptions of rational choice that conceptualize criminal behaviour as conscious decision-making that is guided by opportunities and cost-benefit calculations (e.g. Clarke and Felson 1993; Cohen and Felson 1979; Sidebottom and Wortley 2016), including the repetition of once successful criminal activities (e.g. Farrell and Pease 2014; Johnson *et al*. 2007).

In PRECOBS, future burglaries are predicted through an estimation of individual offender behaviour based on so-called trigger incidents. The functionality

of the software package revolves around the notion that from these trigger incidents, a spatially and temporally connected occurrence of follow-up offences can be predicted. Underpinning here is the assumption that most burglaries are committed by professional criminals who identify profitable target areas, strike multiple times within a short time period, and then move on before the police can react and come up with adequate countermeasures. These professionals, so the rationale goes, can be distinguished from non-professionals through the characteristics of the offence (i.e. the modus operandi). Thus, if a reported burglary is characterized by non-violent and silent ways of gaining access to the dwelling, as well as easily transportable haul with a high resale value, the assumption would be that the offence was committed by professionals and that the same offenders would strike again in the same neighbourhood within a short timeframe.

In order to assess whether a recorded burglary should in fact be regarded as a trigger incident and whether preventive measures should be undertaken in that neighbourhood, PRECOBS processes crime data logged by the police, notably making use of the variables 'time of the incident', 'modus operandi', 'haul', 'type of dwelling', as well as the GIS coordinates (Schweer 2015: 13). If, through the algorithmic analysis of such data, a supposedly professional burglary is identified, the software triggers an alert that specifies the likelihood of follow-up offences within a radius of 400 metres and a timeframe of up to seven days (the highest likelihood for near-repeats falls within the first three days). The software allows for an adjustment of both the spatial dimension (the radius can be reduced or expanded, and manually adapted to fit the topographic characteristics of a neighbourhood) and the duration throughout which the alert is to remain valid. Alerts are double-checked by human operators in order to reduce false positives and are then circulated to operational planning and dispatch divisions within the police department, where increased street patrols and other preventive measures in the identified areas are scheduled.

Predictive policing manufacturers such as IfmPt thereby advertise their commercial software packages in ways that suggest live awareness of any situational changes through continuous and automated analyses 'as new crimes come in'[3] or 'receiving current crime data'.[4] The sales pitch here is that future crime risk can be continuously updated and thereby enable maximum responsivity of police work, so that street patrols can be flexibly reorganized whenever new alerts occur. Predictive policing is in this sense imagined as an uninterrupted process that continuously produces and adjusts criminal futures, in the best case scenario executed in an automated fashion in order to provide as much real-time support for police work as possible – and at the same time requiring as little human input as possible. The narrative that underpins algorithmic security tools more generally is in fact often one of automation and seamlessness, whereby live data goes into the system and is analysed in real-time, so that the results can then be circulated back into the context of application without substantial time lags, thus guaranteeing maximum timeliness of security production (e.g. Amoore 2009, 2011; Leese 2014; Massumi 2007).

What results from such an angle is an imaginary of an always-present relationship with the future, creating minimum response times to whatever security threat might be identified through the ongoing stream of live data. This idea of seamlessness corresponds with a supposedly dynamic and contingent threat environment in which security agencies need to be able to quickly react and adapt, and therefore keep their situational awareness at a maximum level at any time. As Aradau and Blanke (2017: 384) put forward, when it comes to security, algorithmic analytics are indeed 'not primarily about the turn to the future but about near-real-time decision-making'. The assumption here is that on the operational level, flexibility and reactive capacities would crucially rely on continuous situational analyses in order to empower effective interventions. From a technological vantage point, such a seamless and continuous mode of algorithmic prediction would certainly be possible, as there are in fact few limitations when it comes to real-time processing capacities of live data streams. One software developer described how predictive policing software could in theory be implemented into police work:

> You can run that in a fully automated fashion, that's no problem. Technology can do anything. The system can process any kind of data. You can process personal data, you can process different data from different sources – that's no problem from a technical point of view.
>
> (Interview, 9 June 2016)

Such an angle speaks closely to the managerial logic that is inherent in the idea of predictive policing in the first place: Only when the software blends seamlessly into its operational environment and commands no specific attention can the dictum of 'doing more with less' be efficiently realized. And only then can algorithmically generated predictions be translated into street patrols who arrive at the crime scene before the criminal in order to capture the offender – or at least prevent the offence from its materialization. While such a techno-narrative is a compelling one, it must however not be confused with the actual ways in which technological tools become implemented within institutions and work routines. Once rolled out into the 'real world', technologies often become used in unforeseen and creative ways (Pinch and Bijker 1984) that are quite distinct from their developer's original intentions or marketing narratives and unfold unforeseen (side-)effects (e.g. Collingridge 1981; Tenner 1997; Winner 1980). In other words, if we seek to understand the repercussions of new technologies, we must take into account how they become appropriated and used on an everyday basis.

The emergence of cyclical futures

Predictive policing must in this sense not be understood as merely a technological tool, but as a socio-technical assemblage (Law 1991) that requires special attention to its specific forms of implementation and practice. Only through

such contextualization can transformations of policing by means of new algorithmic software packages be adequately addressed (e.g. Bennett Moses and Chan 2016; Kaufmann 2018; Sanders and Condon 2017; Smith *et al*. 2017). The specific modes of bringing criminal futures into being with PRECOBS thus command an empirical perspective on the use of the software package within institutional environments and organizational work routines. In fact, empirical research within multiple police departments revealed that PRECOBS was not used in an automated and continuous fashion, but rather in quite static and non-automated ways. One major reason for this could be found in larger relationships between crime and the organization of police work. As one interviewee explained how the software package was implemented into the work routines of their department:

> Our officers who respond to the call will log the burglary. […] We used to have a little black notebook into which everything was entered, but now they have iPads – we are fully equipped when it comes to that. And there is a simplified reporting form, where the main characteristics are retrieved: what is the exact timeframe of the offense, the specifics of the area, what was stolen, modus operandi? All that goes into the database on-the-fly. And there, you could have automated queries. But in our department, we have to put the data on a flash drive, because we run [PRECOBS] as a stand-alone solution, and we have to load the data into the system.
>
> (Interview, 1 June 2016)

What is striking in this statement, first of all, is that the PRECOBS is used as a stand-alone solution, meaning that the system is not online, or even automatically connected with the central database that police departments use for recording and administering crime data. Even though logging procedures at the crime scene are digitized and central database updates can therefore be realized almost in real-time, the software is installed on a notebook computer with no network connection. This practice speaks to both data protection requirements and maintenance procedures, as the system can through a separation from the police intranet be updated and tweaked easily and without time-consuming bureaucratic procedures (Interviews, 20 March 2017; 16 August 2017).

This separation however produces a situation in which, prior to any actual analysis, crime data has to be transferred to the notebook via flash drive and then manually imported into the software.[5] The operator then runs the program and double-checks any potential alert outputs before producing a brief summary (usually a one-page pdf file per confirmed alert prognosis) of the situational analysis that is subsequently passed on to the operational planning unit. The analysis of crime data is thereby executed only once per day. Once the analysis is finished, the notebook with the PRECOBS software package is stowed away for the rest of the day and only reopened on the following day. Such a once-per-day approach to predictive policing appears puzzling at first sight, as it contradicts the manufacturer's ambitions of seamlessness and real-time situational analysis, and

at the same time seemingly undercuts the reorganization of police work around the principles of efficiency and effectiveness. The once-per-day way of using PRECOBS must however be understood against the backdrop of larger temporal relations between crime and the policing thereof. As one interviewee put it:

> 'That takes place every morning. We log the burglaries of the previous night […] and then we export the past 24 hours or simply the whole dataset, and that goes into the system again.'
>
> Q: 'The dataset is updated every day?'
>
> 'Yes. The system – well it's not exactly 24 hours, but a longer timeframe that we import, but the system checks whether entries have already been processed or not. Because the burglary could have been logged retroactively, from an earlier point in time.'
>
> (Interview, 16 August 2017)

What becomes apparent from this statement is the fundamental and essentially unresolvable predicament that the police face with regard to the asynchronicity of crime and police work. In other words, there will always be a time lag between the occurrence of crime and its detection, reporting, logging, and analysis. All of these consecutive steps however need to take place before, based on the eventual analysis of crime data, preventive measures based on algorithmic calculations can be brought to the street level. This temporal predicament is particularly pertinent for burglaries, as offenders usually strike when residents are not at home. Consequently, many offences will only be detected hours or even days after their occurrence, and even if they are immediately reported and officers are instantly available to log them, substantial time will pass between the actual burglary and the analysis of the ensuing data. Any aspirations of real-time situational awareness and flexibility are therefore undercut by the condition of asynchronicity in the first place, which is why the police in fact consider a once-per-day rhythm of crime prediction sufficient:

> At the moment we have a daily rhythm. We could adjust that, but usually there isn't much dynamic here, so that you would have to do that every hour. If you have the data in the system, you could of course update every minute. But we realized that once per day is enough for situational analysis. In the morning, you have to determine which new burglaries came in, because what happened over night is usually noticed in the morning and then reported. That means you wait until you can include these and analyze them for the daily situational analysis, and that's enough.
>
> (Interview, 1 September 2016)

This is not to say that the police would not make a dedicated effort to log crimes and create crime data as quickly as they possibly could. Quite on the

contrary, among the researched departments, most used digital devices at the crime scene, so that the created data could be automatically transferred to the central database system. This acceleration would, however, not resolve the fundamental asynchronicity inherent in the policing of burglaries. As one interviewee described the time lag dilemma faced against the backdrop of effective crime prevention in their everyday work in detail:

> We have the data in the central system after 15 minutes or half an hour. But getting ahead of the situation more than that, I doubt that this will be possible. Because the current series that happened during the day or during the night – I will only find out about that on the next morning. That I'll be so close to the situation that I log a crime and the burglars are still active in that very same street – I wouldn't say that never happens, but it is very rare. I log a burglary, and then another one, but those happened three hours ago, or four hours. And then I need to get ahead of the situation for the next cycle, when the offender could return, and that's 24 hours.
>
> (Interview, 22 June 2017)

The temporalities of predictive policing, as these accounts demonstrate, must thus be understood in close conjunction with crime itself and the corresponding organization of police work. In the case of PRECOBS and its focus on burglaries, the assumption is that most burglaries are committed by professionals who act rationally and strike within certain timeframes when there is the least risk of being caught, thus leading to the occurrence of offences in cycles of 24 hours. From such considerations, the implementation of PRECOBS in the researched departments has logically emerged as a once-per-day activity that derives from the operational requirements of everyday police work. These cyclical futures cover a comparatively short time horizon that falls in line with the organizational culture and requirements of policing. And even though they could be considered as merely small fragments of foresight, they do in fact constitute a never-ending puzzle that is continuously assembled at the speed of one piece per day.

Limited resources and institutional ponderousness

The empirically diagnosed 24-hour rhythm of crime prediction not only stands in stark contrast to imaginaries of 'live crime data' and 'real-time analysis', but it becomes further reinforced by organizational structures within the police as an institution. Predictive policing must not be reduced to situational analysis, but can unfold an impact on crime prevention only when, in a second step, predictions are put into practice on the street level (e.g. Bennett Moses and Chan 2016; Perry *et al*. 2013). This in turn means that the implementation of criminal futures must fit in with the requirements of different police divisions. Notably, operational planning and dispatch units occupy a central position in practices of predictive policing, as available forces need to be scheduled for street patrols

and other preventive measures according to the produced crime predictions. However, within larger trajectories of limited personnel resources and the need for flexible rescheduling that the use of predictive policing software presupposes, a certain institutional ponderousness can be encountered. Interviewees from different police departments described the problems of work organization and the potential disruptions posed by a continuous use of PRECOBS as follows:

> We pass on the information to the operational planning division who are responsible for operational measures. And they also have to do their scheduling. So if I tell them at 9:00 that we have an alert, and we have these personnel resources available and assign them to the alert – and then at 11:00 I tell them that we have another alert, then that's not an efficient process, because they will have to reschedule. Or they can't react at all. That means there will be no benefits from faster communication of alerts.
>
> (Interview, 22 June 2017)

> The main issue is of course the response time of the operative units. Because let's be honest, […] when we have an alert at 8:00, and another one at 16:00, our forces probably won't be able to react, or only on a limited scale. And that's a problem, of course. We don't have the capacities.
>
> (Interview, 6 July 2017)

These quotes quite aptly illustrate the dilemma that police departments face in the use of predictive policing software: In order to realize the potential of increased efficiency and effectiveness, a certain level of flexibility is required, and such flexibility is in turn tied to the availability of sufficient personnel resources. In other words, whereas the managerial aspiration of predictive policing is to resolve the quandary of shrinking budgets and decreasing numbers of available personnel on the ground through a flexible and target-oriented reallocation of resources, such an implementation would still require sufficient resources in order to enable police departments to be responsive to this newly acquired flexibility.

As put forward by many of the interviewees, particularly in less urban environments, a major obstacle would be the fact that there simply would not be enough forces available to be able to react to potential live situational updates and to adapt preventive measures in new risk areas. From an organizational angle, the once-per-day mode of addressing the future was thus again seen as sufficient, as institutional inertial force would prevent a real-time level of responsiveness anyway. Once more, what becomes apparent here is a discrepancy between the imaginary of algorithmically supported policing through situational awareness, and actual practices that were limited by a set of institutional and organizational constraints. The prospect of having to constantly reallocate personnel resources was thereby regarded as inefficient in itself, as the resources required would outweigh the potential benefits.

Such institutional ponderousness in predictive policing becomes furthermore aggravated when multiple alerts are active at the same time. With each new alert, a new criminal future becomes inscribed in space and time and adds an additional layer to the set of futures that must be reacted to. Predictions created with PRECOBS remain active for a period of up to seven days, during which according to near-repeat theory an increased likelihood of follow-up burglaries can be expected. In the researched police departments, against the backdrop of limited personnel resources, operational planning and dispatch divisions were thus struggling with the amount of simultaneous alerts, even as they were produced only once per day. As one interviewee aptly summarized the situation: 'We have to prioritize. We have three alerts, which one should we prioritize?' (Interview, 6 July 2017)

Predictive policing thus pushes existing organizational structures in police departments to the brink in two closely related ways. First of all, available personnel resources were in the researched departments not fit for flexible rescheduling and short response times to real-time situational updates. Quite on the contrary, the police already struggle with their resources in times of budget cuts. And second, whereas predictive policing starts from the idea of enabling police departments to 'do more with less', notions of efficiency and effectiveness could presumably be mobilized as arguments against budget increases, as an assignment of additional resources would contradict the managerial attractiveness of predictive policing in the first place.

Conclusion

From the analysis of the practices of predictive policing in multiple German and Swiss police departments presented throughout this chapter, several conclusions can be drawn with regard to the modes in which criminal futures are addressed and rendered actionable. First of all, and generally speaking, the time horizon of predictive policing is a comparably short one. Unlike other domains that prescribe mid-term or long-term engagement, such as global health (Jasper 2020), crime can only meaningfully be subjected to predictions on a scale of a few days. Second, practical forms of the implementation of predictive policing software follow entrenched institutional structures and organizational routines of the police as an institution rather than speaking to techno-imaginaries that are predicated upon notions of seamlessness, automation, and real-time. Third, limited personnel resources and ensuing institutional ponderousness further aggravate the static ways in which algorithmic software packages become part of everyday police work.

As near-repeat theory presupposes that the likelihood of follow-up crimes is at the highest within close spatial and temporal proximity of the initial offence, in the researched departments, alerts remained active for a timeframe of up to seven days. The futures that are brought into being within predictive policing are thus kept on a limited time horizon, as their purpose is to enable short-term prevention measures. If analytical foresight follows the operational aspiration to

anticipate and preempt the next move of professional criminals, then this must be done within a couple days or the prediction itself will have been in vain. Criminal futures in the form of spatio-temporal risk alerts are thereby considered as relatively stable and need not be further updated after they have been calculated once. They do however become supplemented by new layers of criminal futures in cycles of 24 hours, so that the short-term horizon of predictive policing is constantly renewed in both time and space.

The idea of short-term futures thereby closely speaks to the temporal characteristics of crime and the corresponding organization and institutionalization of police work. The asynchronicity between crime and police work, as well as the assumption of 24-hour cycles between burglaries that are connected through near-repeat patterns, render it sufficient to address the future in a once-per-day fashion in order to prepare for the ensuing iteration of criminal activity. Moreover, as algorithmic predictions must be enacted through preventive measures on the street level, limited resources and organizational routines of distinct police divisions interfere with ideas of flexibility and responsiveness. Instead, predictive policing becomes characterized by institutional ponderousness that stems from already limited resources. Empirically, predictive policing thus comes into being as a practice that is limited by larger institutional and organizational contexts of police work, thus resulting in the empirically encountered forms of implementation.

It should however be kept in mind that predictive policing is a comparably recent phenomenon. There are still relatively few commercial software packages available, and many police departments that have not yet implemented any of them are running trials in order to figure out how to use algorithmic support most effectively and efficiently. The same is true for the manufacturer side: The PRECOBS software package is regularly revised, and engineers and designers are responsive to the operational needs of the police. At the time of writing (December 2017), IfmPt has announced the roll-out of a new software version that pushes further into automation and integration into police databases through a server-based architecture that allows for networked access and analysis. Other police departments are designing or already implementing custom-built predictive policing tools (Interview, 7 March 2017). And more mobile devices such as smartphones and tablets for street patrols mean that communication between situational analysts and officers on the ground could become quicker and more direct.

It will remain to be seen how such new developments will further alter predictive policing practices, and whether the institutional and organizational constraints sketched out in this chapter will remain in place. After all, what will not change is the asynchronicity of crime and policing, and the organizational routines built around this relationship. As one police officer neatly summed up this fundamental condition:

> It is of course possible that others argue that it makes more sense to run the analysis twice per day, or four times per day, or even continuously. But I think we should not forget that we are speaking about an overall situation.

> […] You must not overexert your people with continuous new alerts. You run your situational analysis in the morning, and that's just like the weather: what will the weather be like for today? You don't want to be constantly updated, and usually that is not necessary either.
>
> (Interview, 1 September 2016)

Notes

1 The research for this chapter was partly funded by the Fritz Thyssen foundation (Grant No. 10.16.2.005SO). Much appreciation goes to Simon Egbert for constructive comments on an earlier version of this chapter.

2 Institut für musterbasierte Prognosetechnik (Institute for Pattern-Based Prediction Technique), www.ifmpt.com (accessed 17 November 2017).

3 PredPol, www.predpol.com/technology (accessed 17 November 2017).

4 PRECOBS, www.ifmpt.com (accessed 17 November 2017).

5 It should be noted here that, although throughout the majority of the researched police departments, this was the standard procedure, one department had established a direct link between PRECOBS and its central database, so that crime data did not have to be imported manually (Interviews, 7 March 2017; 24 July 2017).

References

Amoore, L. (2009) 'Algorithmic War: Everyday Geographies of the War on Terror', *Antipode* 41(1): 49–69.

Amoore, L. (2011) 'Data Derivatives: On the Emergence of a Security Risk Calculus for Our Times', *Theory, Culture and Society* 28(6): 24–43.

Andrejevic, M. (2017) 'To Preempt a Thief', *International Journal of Communication* 11: 879–96.

Aradau, C. and Blanke, T. (2017) 'Politics of Prediction: Security and the Time/Space of Governmentality in the Age of Big Data', *European Journal of Social Theory* 20(3): 373–91.

Beck, C. and McCue, C. (2009) 'Predictive Policing: What Can We Learn from Wal-Mart and Amazon about Fighting Crime in a Recession?', *The Police Chief* 76(11).

Bennett Moses, L. and Chan, J. (2018) 'Algorithmic Prediction in Policing: Assumptions, Evaluation, and Accountability', *Policing and Society* 28(7): 806–22.

Clarke, R. V. and Felson, M. (1993) *Routine Activity and Rational Choice*, New Brunswick: Transaction Publishers.

Cohen, L. E. and Felson, M. (1979) 'Social Change and Crime Rate Trends: A Routine Activity Approach', *American Sociological Review* 44(4): 588–608.

Collingridge, D. (1981) *The Social Control of Technology*, London: Palgrave Macmillan.

Dallke, J. (2017) 'Chicago PD Sued over Crime Prediction Algorithm', *ChicagoInno*, 8 June. Online. Available: www.americaninno.com/chicago/chicago-pd-sued-over-crime-prediction-algorithm (accessed 30 November 2017).

Egbert, S. (2017) 'Siegeszug der Algorithmen? Predictive Policing im deutschsprachigen Raum', *Aus Politik und Zeitgeschichte* 67(32–33): 17–23.

Farrell, G. (1995) 'Preventing Repeat Victimization', *Crime and Justice* 19: 469–534.

Farrell, G. and Pease, K. (2014) 'Prediction and Crime Clusters', in G. Bruinsma and D. Weisburd (eds) *Encyclopedia of Criminology and Criminal Justice*, New York, Heidelberg, Dordrecht, London: Springer, 3862–71.

Farrell, G., Phillips, C. and Pease, K. (1995) 'Like Taking Candy: Why does Repeat Victimization Occur?', *British Journal of Criminology* 35(3): 384–99.

Gluba, A. (2014) 'Predictive Policing – eine Bestandsaufnahme: Historie, theoretische Grundlagen, Andwendungsgebiete und Wirkung', *Kriminalistik* (6): 347–52.

Gluba, A. and Pett, A. (2017) 'Predictive Policing: Ein (un)bekannter Ansatz: Definition, Ursprung und Rahmenbedingungen', in M. H. W. Möllers and R. C. van Ooyen (eds) *Jahrbuch Öffentliche Sicherheit 2016/2017*, Frankfurt: Verlag für Polizeiwissenschaft, 431–40.

Gorner, J. (2013) 'Chicago Police Use "Heat List" as Strategy to Prevent Violence', *Chicago Tribune*, 21 August. Online. Available: http://articles.chicagotribune.com/2013-08-21/news/ct-met-heat-list-20130821_1_chicago-police-commander-andrew-papachristos-heat-list (accessed 30 November 2017).

Hildebrandt, M. (2016) 'New Animism in Policing: Re-Animating the Rule of Law?', in B. Bradford, B. Jauregui, I. Loader and J. Steinberg (eds) *The SAGE Handbook of Global Policing*, London, Thousand Oaks, New Delhi, Singapore: Sage, 406–28.

Jasper, U. (2020) 'The Anticipative Medicalization of Life: Governing Future Risk and Uncertainty in (Global) Health', in A. Wenger, U. Jasper and M. Dunn Cavelty (eds) *Probing and Governing the Future: The Politics and Science of Prevision*, London and New York: Routledge, 122–40.

Johnson, S. D., Bernasco, W., Bowers, K. J., Elffers, H., Ratcliffe, J., Rengert, G. and Townsley, M. (2007) 'Space-Time Patterns of Risk: A Cross National Assessment of Residential Burglary Victimization', *Journal of Quantitative Criminology* 23(3): 201–19.

Kaufmann, M. (2018) 'The Co-Construction of Crime Predictions: Dynamics Between Digital Data, Software and Human Beings', in H. O. Gundhus, K. V. Rønn and N. R. Fyfe (eds) *Moral Issues in Intelligence-Led Policing*, London: Routledge, 143–60.

Law, J. (1991) 'Introduction: Monsters, Machines and Sociotechnical Relations', in J. Law (eds) *A Sociology of Monsters: Essays on Power, Technology and Domination*, London, New York: Routledge, 1–23.

Leese, M. (2014) 'The New Profiling: Algorithms, Black Boxes, and the Failure of Anti-Discriminatory Safeguards in the European Union', *Security Dialogue* 45(5): 494–511.

Manning, P. K. (2008) *The Technology of Policing: Crime Mapping, Information Technology, and the Rationality of Crime Control*, New York, London: New York University Press.

Mantello, P. (2016) 'The Machine that Ate Bad People: The Ontopolitics of the Precrime Assemblage', *Big Data and Society* 3(2): 1–11.

Massumi, B. (2007) 'Potential Politics and the Primacy of Preemption', *Theory and Event* 10(2): 1–21.

McCue, C. (2007) *Data Mining and Predictive Analysis: Intelligence Gathering and Crime Analysis*, Burlington, Oxford: Elsevier.

McCue, C. and Parker, A. (2003) 'Connecting the Dots: Data Mining and Predictive Analytics in Law Enforcement and Intelligence Analysis', *The Police Chief* 70(10): 115–24.

Perry, W. L., McInnis, B., Price, C. C., Smith, S. C. and Hollywood, J. S. (2013) *Predictive Policing: The Role of Crime Forecasting in Law Enforcement Operations*, Santa Monica: RAND Corporation.

Pinch, T. J. and Bijker, W. E. (1984) 'The Social Construction of Facts and Artefacts: Or how the Sociology of Science and the Sociology of Technology Might Benefit Each Other', *Social Studies of Science* 14(3): 399–441.

Polvi, N., Looman, T., Humphries, C. and Pease, K. E. N. (1991) 'The Time Course of Repeat Burglary Victimization', *British Journal of Criminology* 31(4): 411–14.

Sanders, C. and Condon, C. (2017) 'Crime Analysis and Cognitive Effects: The Practice of Policing *through* Flows of Data', *Global Crime* 18(3): 237–55.

Saunders, J., Hunt, P. and Hollywood, J. S. (2016) 'Predictions Put into Practice: A Quasi-Experimental Evaluation of Chicago's Predictive Policing Pilot', *Journal of Experimental Criminology* 12(3): 347–71.

Schweer, T. (2015) ' "Vor dem Täter am Tatort": Musterbasierte Tatortvorhersagen am Beispiel des Wohnungseinbruchs', *Die Kriminalpolizei* 32(1): 13–16.

Sidebottom, A. and Wortley, R. (2016) 'Environmental Criminology', in A. R. Piquero (eds) *The Handbook of Criminological Theory*, Chichester: Wiley Blackwell, 156–81.

Smith, G. J. D., Bennett Moses, L. and Chan, J. (2017) 'The Challenges of Doing Criminology in the Big Data Era: Towards a Digital and Data-Driven Approach', *British Journal of Criminology* 57(2): 259–74.

Stanley, J. (2014) 'Chicago Police "Heat List" Renews Old Fears about Government Flagging and Tagging', *ACLU*, 25 February. Online. Available: www.aclu.org/blog/privacy-technology/chicago-police-heat-list-renews-old-fears-about-government-flagging-and (accessed 30 November 2017).

Tenner, E. (1997) *Why Things Bite Back: Technology and the Revenge Effect*, London: Fourth Estate.

Townsley, M., Homel, R. and Chaseling, J. (2003) 'Infectious Burglaries: A Test of the Near Repeat Hypothesis', *British Journal of Criminology* 43(3): 615–33.

Winner, L. (1980) 'Do Artifacts Have Politics?', *Daedalus* 109(1): 121–36.

Part IV

Conclusion

14 The politics and science of the future

Assembling future knowledge and integrating it into public policy and governance

Andreas Wenger, Myriam Dunn Cavelty and Ursula Jasper

In a world of complexity, interconnectedness, uncertainty, and rapid social, economic and political transformations, policy-makers increasingly demand scientifically robust policy-advice as a form of guidance for policy-decisions. As a result, scientists in academia and beyond are expected to focus on policy-relevant research questions and contribute to the solution of complicated, oftentimes transnational, if not global policy problems. Being policy-relevant means to supply future-related, forward-looking knowledge – a task that does not come easy to a profession that traditionally focuses on the empirical study of the past and present, values the academic freedom of inquiry, and often sees its role in society as confronting and challenging power and hierarchy.

Contributing future knowledge towards the sustainable solution of complex problems can be rewarding and it is an important basis for fostering and maintaining trust between science, society, and politics. However, creating future knowledge can also be a thankless task and, worse, backfire, fuelling pessimism towards science (Pielke 2007). On top of that, future knowledge is political, because the science and the politics of anticipating and preparing for the future are closely intertwined and cannot be separated: It shapes perceptions about the future and such perceptions do not simply provide orientation between the past, the present, and the future – once future knowledge is acted upon, it influences and changes the course of the future. Conversely, institutions and governance structures influence the making of knowledge about the future, acknowledging, selecting, and legitimizing some forms of future knowledge provided by some experts and institutions, while precluding other forms (Jasanoff 2015).

This concluding chapter, building on the individual contributions to this book, highlights the complex interactions and feedback-loops between the politics and the science of the future. The two interrelated and oftentimes parallel processes of creating and assembling future knowledge and the integration of this knowledge into public policy-making and governance bring policy-makers and scientific experts from within governments, private industry, and academia in close contact with each other. While this may create friction at the intersection of

science and policy, such friction can also unleash human creativity resulting in better future policies and practices while expanding the horizon of possibility. If politics and science more actively reflect differences and overlaps in their knowledge conceptions and roles in society, they will be better equipped to master the challenges of collaboration and overcome the unavoidable backlash of working at the intersection of science and politics.

Four factors shaping the context of future-oriented thinking today

Before we discuss the intricacies and fallacies of integrating future-oriented science and politics based on the findings of the book, we would like to point out four characteristics of the current context that shape today's environment (see Figure 14.1). The introductory chapter of this book presented the co-constitution and co-evolution of different historical imaginaries of the future and social and political orders across time from a Western point of view (Wenger *et al*. 2020). While the chapters of this book have focused almost exclusively on the West as well, it is in fact the emergence of alternative visions of the future in the East,

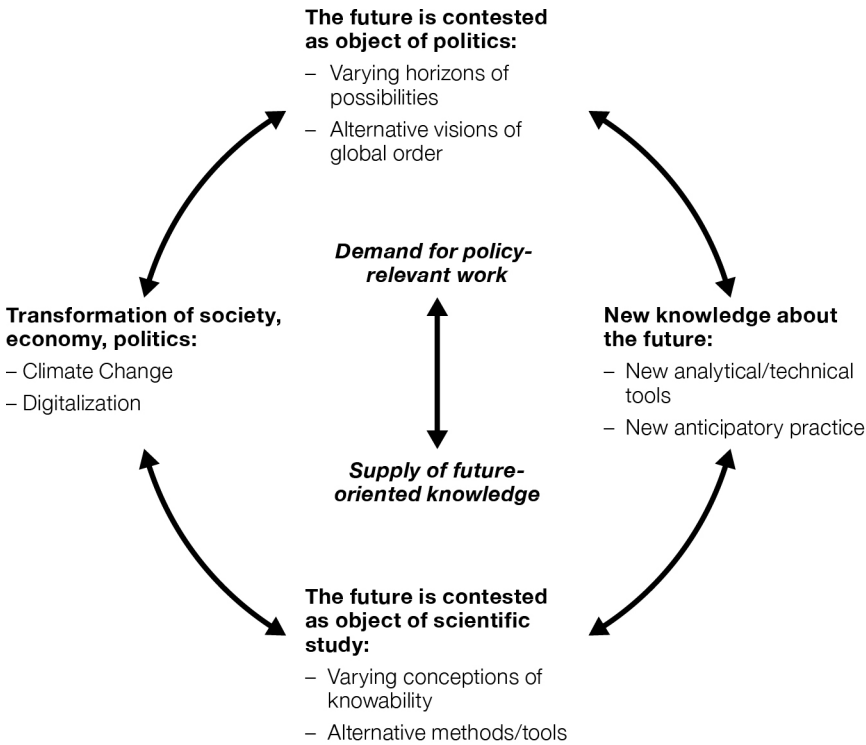

Figure 14.1 The current context of future-oriented thinking.

especially in China, that provide a major impetus for the renewed political interest in the future. Competing and sometimes clashing visions of the future need to be increasingly negotiated at the global level and integrated not just into national policy but into global governance systems (Simandan 2018). This situates the future as a contested object of politics firmly on international relations and security studies territory.

The past decade in global politics is characterized by discussions about the consequences of a changing power distribution between the West and the East with many open questions about future order remaining (Maull 2018). Not least because of the lingering effects of the financial crisis of 2008, policy-makers in the Western world tend to fall back onto a discourse that paints the world as complex, uncertain, and unpredictable, full of risks that cannot easily be controlled and major ruptures that are inevitable (and often unforeseeable). At the same time and as an extreme counterweight, China's state-driven modernization project came to be seen as an alternative development model to the world (Breslin 2011; Zhao 2010; Zeng 2019). The launching of the 'One Belt, One Road' Initiative in 2013 (now just Belt and Road Initiative, BRI) – a gigantic infrastructure project connecting China with Europe through a series of continental and one maritime corridors – marked a major turning point in Beijing's geo-economic strategy (Ferdinand 2016; Jones and Zeng 2019).

The shifts in global economics and politics are in line with asynchronous shifts in the temporal thinking in Western and in Chinese politics. While for Western policy-makers the horizon of possibilities seems to be shrinking, for Chinese policy-makers it seems to be expanding. In the West the future is debated in a context of political fragmentation and rising populism. In China the future is associated with a revival of historical greatness after a century of humiliation (Westad 2020; Zheng 2012). Neither Western nor Chinese policy-makers perceive the future through the temporal regime of Francis Fukuyama's presumed 'end of history' any longer (Fukuyama 1992). On the contrary, their different visions of the future reflect competing and alternative visions of regional and global order. In a world in which the liberal order is clearly no longer universally acknowledged and the rule-based capacity to act at the international level seems limited, the future as an object of (international) politics cannot *but* be contested.

Not least because of the 'failure' to anticipate and predict key global events, the future is a contested object of study in the social sciences and beyond as well (Assmann 2013; Hölscher 2017; Jasanoff and Kim 2015). The past decade witnessed a growing debate about the epistemological challenges of making claims about the future. Like in politics, this debate evolves as science and academia more broadly are changing as well (Nowotny *et al*. 2001; Schimank 2012). On the one hand, the international scientific system has expanded greatly over the past decade, with different social and political contexts leaving more or less room for academic freedom. Moreover, scientific knowledge is not only – and in some fields like artificial intelligence no longer primarily – produced in universities that are characterized by a disciplinary and autonomous organization of

knowledge production, but increasingly by more diverse actors from different sectors of society that represent a more transdisciplinary, applied, and reflexive organization of science (Gibbons *et al*. 1994; Dusdal 2017).

Next to these changes in politics and science, we see two meta-processes that not only affect all societies and political systems in one way or another but are also influencing the public demand for policy-relevant work in general and scientific supply of future-oriented knowledge in particular. The first is climate change and related issues. It expands the temporal horizon of contemporary policy-making by increasing the time span between cause and harmful effect considerably and thereby accentuates distributional conflict at the global level and across generations. The future thus becomes a mere extension of the present, as scholars like Sheila Jasanoff and Helga Nowotny point out. Together with other global challenges like financial instability, emerging diseases, or internationalized civil wars – that all have transnational regional and global economic, social, and political consequences – climate change stands for a big, global challenge that no single political actor can deal with on its own. Second, transformative new technologies, especially in the field of artificial intelligence, promise huge potential benefits for the digitalized society of the future but at the same time create room for new, and potentially huge risks (Fischer and Wenger 2019). These technologies whose development is dominated by large global technology companies and some universities stand for potentially sweeping transformations across sectors and societies beyond the control of the state.

Last, these technological, social, and political changes are influencing and are influenced by new tools of future knowledge creation. First, the rapid increase in computing power, the vast growth in data, and the optimization of analytical algorithms have greatly expanded the range of present and future application of AI technologies. On the one hand, these new technologies come with the promise of controlling and managing the future on an unprecedented scale and speed, although the temporal trajectory of the development from narrow to more general forms of AI is highly uncertain. On the other hand, these new technologies, while heavily contributing to the rising scientific interest in the future, create major uncertainties as regards their technological implications (safety, transparency), their social implications (biased decision-making), and their political implications (totalitarian surveillance) (Dafoe 2018).

At the same time, the social and political changes discussed above are also affecting and are affected by new anticipatory policies and practices. First, the export of the precautionary principle from the field of environmental politics to other policy fields, and the stellar ascendancy of the concept of resilience across many fields of public policy and global governance reflect that policy-makers are aware of the limits of future knowledge. In a world of risk *and* uncertainty, policy-makers – reclaiming sovereign decision-making from experts – prepare for non-linear developments, focusing on how best to rebound in unavoidable crises and learn in a decentralized mode (Aradau and van Munster 2007; Ewald 2002). Second, in the context of a transdisciplinary perspective, new forms of

science–policy dialogues are emerging that represent a more reflexive and deliberative organization of future knowledge. Such anticipatory practices integrate public expectations as early as in the definition phase of research problems, map different policy measures and options and explore their political and ethical impact together with public, private, and civilian stakeholders (e.g. Chilvers 2013; Edenhofer and Kowarsch 2015).

After laying out the current context in thinking about the future from a Western perspective, this concluding chapter proceeds as follows to summarize the findings of this book: A first section highlights how different knowledge conceptions and temporal logics of and within politics and science complicate the process of creating and assembling future knowledge. It then explores how a better understanding for the interlinkages between method, practice, context, and political purpose of different types of future reasoning can facilitate the collaboration between policy-makers and scientists. A second section highlights what emerges from the empirical chapters in this volume. It discusses how risks and uncertainty are dealt with across different policy-fields, from climate, health, and financial markets to biological and nuclear weapons proliferation, civil war, and crime. We compare whose predictions and forecasts are integrated how deeply into what forms of governance systems and what consequences this has for politics, society, and science.

Creating and assembling future knowledge at the intersection of science and politics

Future knowledge is created and assembled at the intersection of science and politics. This process brings two systems in close contact with each other that ideally fulfil different roles in society (‘deciding’ vs. ‘learning’) (Maasen and Weingart 2005). As a consequence, the knowledge produced in academia is not automatically the same as that required in politics. In fact, science and politics are not only guided by different knowledge conceptions, they also differ in the temporal logic of thinking and acting. Keeping this in mind helps to dissolve the paradox of a growing demand for policy-relevant scientific knowledge amidst widespread disenchantment about academia in policy circles; but also of academia’s growing willingness to contribute to the solution of big social problems amongst the disposition of many scientists to keep a critical distance from politics and the structures of power policy-makers represent.

Politics is primarily geared towards deciding and its temporal orientation is toward the future. Knowledge in politics is used strategically to solve public conflicts, through deliberation and compromise in democratic politics or through directives and hierarchy in more authoritarian and technocratic politics. Science, by contrast, is primarily geared towards learning and its temporal orientation is towards the present and the past. Knowledge in science is systematically developed through the scientific process, i.e. through the systematic collection of empirical data to investigate and/or explain a phenomenon and through the peer review of research results (Maasen and Weingart 2005; Adam 2010). Scientific

knowledge is often associated with objectivity and has a tendency to shy away from the normative or moral question of how this knowledge should be used or not used by society. The traditional disposition of basic research in universities is to stay away from politics which is (quite rightly) associated with the strategic use of knowledge.

Yet politics is not just about the closure of political conflict, as science is not just about systematically questioning existing knowledge. Future knowledge in politics is also used to create a sense of belonging, linking it to the past and the present for orientation; and it is also a site through which human creativity and agency manifests itself in order to solve concrete societal problems. Scientific knowledge left the confines of universities long ago through the successful transfer of research methods, results, and young academics into other sectors of society – including public administration, industry, and civil society organization – thereby fostering competing centres of knowledge production. As a consequence, the process of creating and assembling future knowledge is increasingly organized in a transdisciplinary mode that emphasizes the dynamic interchange between basic and applied research and the flexible collaboration between producers and users of future knowledge in the context of specific practical applications (Nowotny *et al*. 2001).

The often deplored gap between academia and politics reflects the traditional separation and autonomy of politics and science. However, such a view does not adequately reflect the many nodes of continuous interaction between the two spheres and the many different transmission processes through which future knowledge travels across the boundaries of the two subsystems. Both the STS perspective and the pragmatist perspective introduced in this book reject the strict science/policy, internal/external dichotomies of more traditional views (Jacob and Hellström 2000). Jasanoff in Chapter 2 discusses how from a STS-perspective future knowledge is co-constituted by epistemic, institutional, and social forces. Science influences society, but is itself affected by social factors. Imagining and preforming the future are thus highly political endeavours (Jasanoff 2020). In Chapter 3 Gunther Hellmann adds a pragmatist perspective that conceptualizes both policy-makers and scientists as pragmatist problem-solvers that apply 'know-how' to solve social problems in order to cope. According to this view, future knowledge as 'know-how' is acknowledged in social interaction and through language (Hellmann 2020).

The future is contested in science and politics

The knowledge conceptions and temporal orientation differ not only between politics and science – the future is inherently contested *within* these two subsystems of society as well. There is debate and dispute within science *and* politics about both the epistemology as well as the political and ethical implications of prevision. These different perspectives on and knowledge claims about the future interact in both the processes of creating and assembling future knowledge as

well as the processes of integrating future knowledge in public policy and broader (global) governance systems.

Different scientific disciplines have different epistemological perspectives on the future and these perspectives translate into a great diversity of disciplinary tools and practices of dealing with the future and its uncertainties (Li *et al*. 2012). From the perspective of the natural sciences and engineering, the future needs to be discovered and invented through the creation of new knowledge. From the perspective of positivist social sciences, the future can to some extent be predicted, based on empirical cause–effect explanations. From the perspective of history, sociology, and post-positivism in IR and beyond, the future can be imagined and its possibilities can be explored, based on an understanding of how the past, present, and future are interlinked and based on critical normative knowledge, as Francis J. Gavin discusses in Chapter 5 (Gavin 2020). Only rarely is it obvious to policy-makers which epistemological perspective shapes the future knowledge they seek to act upon, or which type of 'know-how' informs their policy decision. It is such an awareness, says Michael Horowitz, that policy-makers and academics need to foster together so that it is possible to fine-tune expectations about the results of different forecasting activities (Horowitz 2020).

Indeed, different disciplines offer different tools and methods to deal with the uncertainties of the future. The truth claims of these different approaches reflect different conceptions of 'knowability' in relation to the future. The truth claims of theory-guided, backward-oriented positivist predictions are based on data and calculation. The historian's truth claims are based on a narrative that is sensitive to specific events *and* structural causes which appreciates that history evolves in a non-linear mode. From a pragmatist perspective, the truth claims are based on social acknowledgement and acceptance; a view that is shared by many STS scholars who in addition highlight the transmission of predictive knowledge across empirical and actor–agency boundaries. Furthermore, different tools of future knowledge production and methods of anticipating the future exhibit a different time horizon as regards the cause and outcome of what is anticipated or predicted.

In politics, different visions of an alternative future are continuously negotiated. Policy-makers intuitively approach the process of imagining the future as a deeply political endeavour that is constitutive for decision-making in the present. Decisions about the future precipitate a specific trajectory, while always precluding alternative futures. Thus, imagining the future and acting upon visions of the future are closely linked to questions of power and democracy. The politics of the future offer opportunities in the present for redistributing power and influence and for promoting alternative policies that align with different values and interests (Mische 2009). The competition between alternative futures at the level of international politics may have far-reaching consequences for the on-going transformation of the global and regional order. The negotiation of alternative futures, at the level of domestic politics, is closely linked to the question of who – among policy-makers, experts, or scientists – has

how much and what type of influence in a given institutional setting, from democratic to more authoritarian regimes (Jasanoff 2020).

Policy-makers usually have a good understanding of the limits of future knowledge and the fact that the ultimate responsibility for decision-making cannot be delegated. They know quite well that they more often than not need to decide in a world of risk *and* uncertainty. On the one hand, policy-makers may also be tempted to manage the risks to their own reputation rather than the primary problem that cannot really be controlled, as Myriam Dunn Cavelty notes in Chapter 6 (Dunn Cavelty 2020). On the other hand, they may stabilize future expectations in the face of uncertainty through social conventions and institutions, as noted by Peter J. Katzenstein and Stephen C. Nelson in Chapter 9 (Katzenstein and Nelson 2020). One example are precautionary policies that allow politics and society to take action even if the cause–effect relationship behind a problem is scientifically not well understood (McLean *et al*. 2009). What emerges from the empirical chapters in this volume is that the move toward precautionary politics can be observed at both ends of the predicted time horizons – the very short one in the context of proactively governing the prevention of crises in the global financial and health systems; and the very long one in the context of climate-adaption policies.

Fitting method and anticipatory practice to context and political purpose

The field of future studies is exhibiting a plethora of methods and modes of anticipatory knowledge-generation. The future oriented-work in academia is highly diverse and characterized by a multitude of different disciplinary tools and practices (Bell 1964). Yet too often – and not only in politics – the different analytical perspectives and epistemological assumptions remain hidden and unexplored. This is of little help for politics and science, particularly for the alignment of mutual expectations with regards to the who, what, when, where, why, and how of creating and assembling future knowledge. In fact, the choice of method which reflects assumptions about the 'knowability' of the future (i.e. levels of scientific uncertainty) and the choice of anticipatory practice that reflects assumptions about the necessary degree of acceptable participation (i.e. levels of normative and political contestation) must fit the object (narrow/broad scope) and the political purpose (political closure/political opening) of prevision.

In Chapter 6 Dunn Cavelty introduces two ideal-types of forward-reasoning that are labelled *prediction* and *forecast* that can serve as a basis for developing a typology for future use (Dunn Cavelty 2020). Prediction comes in the form of traditional risk assessment, a method that relies on statistics and secured knowledge (past data) to calculate the probabilities of an event. As an anticipatory practice, prediction is mostly expert-based and focuses on an epistemological (potentially interdisciplinary) discourse. The assessed cause and outcome generally reflect a narrow scope and a short time horizon. The political purpose of

prediction is to facilitate political closure that allows to compromise on new science-based policies or on risk-based contingency plans. Forecasts, by contrast, come into play when uncertainty is foregrounded in decision-making. Forecasts come in the form of scenarios which represent a method that sketches possible futures in a narrative way. As anticipatory practice, forecasts are geared towards broad participation and focus on a reflective discourse among an interdisciplinary group that represents diverse backgrounds. The explored possible and more or less plausible futures generally reflect a broad scope and a long time horizon. The political purpose of forecasts is to explore different plausible futures and create a policy space for long-term strategic planning.

Both ideal-types of forward-reasoning are currently evolving, as new methods and new anticipatory practices are increasingly becoming available and acceptable, reflecting the broader technological and social trends discussed in the introductory section of this concluding chapter (see Figure 14.1). First, prediction comes increasingly in the form of algorithmic analytics and data-science that relies on growing computing power to establish regularities in huge amounts of data. As an anticipatory practice it is expert-based, at times bringing together the producers and consumers of prediction, and increasingly automated. The assessed causes and outcomes are not always well understood, but the short-term predictive power of such regularities has a potentially broad scope of application. The political purpose of predictive pattern recognition is often early warning and rapid response through dynamic policy adaption – which may change the 'why' and 'for whom' of prediction in an increasingly automated way (Buchanan and Miller 2017).

Second, forecasts increasingly come in the form of more open-ended science–policy dialogues, in which what constitutes a socially relevant research question is already discussed in a participatory way. As an anticipatory practice it is transdisciplinary in nature and emphasizes the dynamic interaction between basic and applied research and the flexible collaboration between multiple producers and users of knowledge. The assessed causes and outcomes are purposefully mapped for a broad set of policy options over the short-, medium-, and long-term. The political purpose of such dialogues is to map the dynamic interaction of technology, markets, and politics and explore different policy measures and options for a specific societal problem together with public, private, and civil stakeholders, thereby providing 'intellectual space' for a deliberative political process about possible futures (Edenhofer and Kowarsch 2015; Grunwald 2014).

Outlining these two ideal-types of forward-reasoning highlights that the choice of method and practice in anticipating the future needs to be made by politics together with science, because the method and practice of creating and assembling future knowledge must fit the object and political purpose of prevision. Over time, we can observe a shift from anticipatory practices that were limited to a one-directional dissemination of scientific knowledge from science to politics to more dialogical practices between policy-makers and scientists – reflecting the growing complexity and interconnectedness of policy problems,

Table 14.1 Different types of forward-reasoning and their evolution

Ideal type of forwardreasoning	*Choice of method*	*Choice of anticipatory practice*	*Context: Scope and time*	*Political purpose*
Prediction: risk	Traditional risk assessment:	Expert-based:	Event prediction:	Political closure:
	–calculation	–epistemological discourse	–short-term	–science-based policies
	–secured knowledge	–potentially interdisciplinary	–narrow scope	–risk-based contingency plans
	Algorithmic analytics:	Expert-based:	Pattern prediction:	Political closure:
	–regularities in big data	–producers and consumers	–short-term	–early warning
	–computing power	–increasingly automated	–broad scope	–rapid response via dynamic adaptation
Forecasts: uncertainty	Traditional scenarios:	Broad participation:	Possible futures:	Political opening:
	–narration	–reflective discourse	–long-term	–create policy space
	–explorative knowledge	–interdisciplinary	–broad scope	–guide strategic planning
	Policy–science dialogue:	Broad participation:	Possible solutions:	Political opening:
	–mix of disciplines, tools, and data	–flexible collaboration between producers and consumers –transdisciplinary	–short-/long-term –specific societal problems / concrete applications	–mapping policy options –deliberation

on the one hand, and the changing relationship between science, society, and politics, on the other (Akin and Scheufele 2017; Doubleday 2008). In a world of risk *and* uncertainty, the key task for policy-makers and scientists in anticipating the future is often to optimally integrate 'analytic and deliberative processes', combining scientific expertise with value orientation (Klinke and Renn 2002).

Moreover, a common understanding of the opportunities and limits of different anticipatory methods helps to see them as mutually supportive rather than mutually exclusive. Risk management approaches and forecasting processes come together in crises decision-making processes when ruptures and continuities meet. The two types of future knowledge need to be combined in order to successfully manage major catastrophes. While predictive knowledge is used to stabilize fluid situations via standard operational procedures (and to automatically adapt such procedures to rapid changes in the environment), knowledge from forecasts can provide orientation when it seems appropriate to break rules and conceptualize crises as an opportunity for learning, (policy) change, and self-reflection (Snowden 2015). Crises situations give rise to a fundamentally normative question: How can 'socially robust knowledge' (Nowotny *et al*. 2001: 166) be produced and applied in order to solve societally salient problems and to achieve societal '"betterment", reconstruction and emancipation' (Bauer and Brighi 2009: 2).

Common goals and critical challenges

Politics and science in a democracy have a strong common interest in a transparent and open process of creating and assembling future knowledge. Knowledge and education are a precondition for broad-based participation and deliberation in democratic processes, especially under conditions of uncertainty and ambiguity (Dewey 1954). 'Fake news' and growing pessimism towards technology, experts, and scientists are undermining social trust and discursive politics. Against this background, politics and academia depend on each other: While the key contribution of scientists in academia is to provide peer-reviewed and transparent (future) knowledge in terms of epistemological premises, methods, and data, the key contribution of policy-makers is to design a deliberative and forward-looking political process that is anchored in democratic participation.

The key challenges for science and academia are twofold: First, scientists in universities must become more flexible and accustomed to work in interdisciplinary and transdisciplinary settings, of course without losing their disciplinary anchoring. Future knowledge is inherently multidisciplinary and combines basic and applied research output in support of policy solutions to complex and increasingly interconnected and international societal challenges. Scientists are expected to be transparent about their epistemological perspectives, methodological choices, and the limits of knowledge they produce. Second, academia should more actively reflect its influence in society – and how social factors influence the development of universities. Scientists have a choice as to when and how they want to engage with politics and what role they want to play in

society (Pielke 2007). Protecting their reputation and the peer-review system that insists on intersubjectively verified knowledge (re)discovery is a legitimate goal, as is to leave the application of new predictive tools to others. Yet academia should insist that it is not marginalized in society as non-academic knowledge providers expand their role.

The key challenges for politics are also twofold: First, politics must come up with a more coherent and transparent policy and process for assembling and integrating future knowledge in public policy and governance. This includes clearly assigned roles and responsibilities within bureaucracies for early warning and horizon scanning, strategic analysis and policy planning, and data protection and management, on the one hand, and the definition of transparent mechanisms for multi-stakeholder involvement in future-related governmental activities, on the other. Second, politics should more actively reflect on the strength and weaknesses of different anticipatory methods and practices and on the ethical and political implications of future knowledge, including what the origin (i.e. industry, university, civil society) of future knowledge means for the dependence of the public sector on these actors in the fulfilment of critical state functions. Protecting its ability to cope with critical challenges under uncertainty and great time pressure is a legitimate goal. Yet politics needs to acknowledge that preparing to efficiently and effectively collaborate across different levels of national and international politics and across society, industry, and politics has become the key for dealing with complex day-to-day problems as well as future crises and catastrophes.

Integrating future knowledge into public policy and governance and its consequence for science, society, and politics

The empirical chapters in this book discuss and analyse how future knowledge is integrated into decision-making. This is when questions of power and democracy are coming to the fore. The politics of the future offers opportunities to (re)negotiate different future visions through a process of social interaction. Future knowledge is not just a tool of policy-making. Once it is integrated in a specific vision of the future and acknowledged – precluding alternative futures – it co-constitutes and precipitates a specific future trajectory. The integration of future knowledge into public decision-making has (sometimes far-reaching) consequences for politics, society, and science and the empirical chapters of the book assess these consequences across different policy fields – from climate, health, and markets to bioweapons, nuclear weapons, civil war, and crime.

Rather than discussing how risks and uncertainty are dealt with in the individual policy fields, we will concentrate on two questions, highlighting and comparing what emerges from the chapters in a comparative perspective. It matters greatly from a political point of view whose predictions are integrated how deeply into what forms of governance systems. Future knowledge may have been created, supplied, and combined by academia, industry, public

bureaucracies or a diverse group of scientists and experts from different backgrounds. This knowledge may be integrated at the national and/or international level of policy-making and inform single-actor or multi-level and multi-stakeholder decision-making processes. The 'who' and 'how' of integrating future knowledge in public policy and (global) governance is addressed in the first subsection below.

The second subsection concentrates on the consequence of decision-making for politics, society, and science. Some of these consequences may crystallize at the global level and reflect competing visions of global order, while other consequences may become visible at the national and sub-national level, within bureaucracies or some other section of society. A recurring theme in a globalized world is that global systems and markets demand global solutions, yet most politics is local and global governance is still weak. Already aligning local, regional, and national interests within states and societies is difficult. Negotiating competing visions of regional and global order at the international level is even more daunting, especially in a period in which alternative future visions among great powers emerge and the associated shifts in temporal thinking in East and West move into opposite directions.

The 'who' and 'how' of integrating future knowledge in public policy and governance

In the following, we proceed in three steps according to the main actor of the prediction. *First*, we discuss the integration and non-integration of academic predictions in policy-making; *second*, we highlight the growing role of private actors in prediction and discuss the different modes of integrating private predictions into varying governance systems; and *third*, we highlight the intricacies of integrating predictive knowledge created by public actors at the national and international levels.

The two chapters on prediction by academia represent two extreme cases in a continuum of fully to not-at-all integrated into policy-making. Whereas the predictions by climate scientists are widely integrated at all level of climate adaptions policy-making, the predictions by conflict researchers so far lack policy relevance and are not directly integrated into policy-making. The now decade-long, deeply politicized row over the contributions and recommendations made by climate scientists is clearly the most visible example of a new form of science–policy interaction (Edwards 2010). Maria Carmen Lemos and Nicole Klenk in Chapter 7 analyse the complexities of climate adaption-decision-making across different levels of government and in a multi-stakeholder setting (Lemos and Klenk 2020). They show how the knowledge that underpins the decision-making is co-produced by science and policy, at times paralyzing politics while politicizing science. Scientists are challenged to predict climate change at the local level – where the uncertainties are bigger than in their global models. These scientific uncertainties, Lemos and Klenk conclude, complicate decision-making, as policy-makers grapple with complex

policy trade-offs between climate-adaption and other socio-economic and political interests.

Academics working in the subfield of conflict research dedicated to the prediction of civil wars and political violence, by contrast, stay aloof from engaging politics and society, as Corinne Bara shows in Chapter 11 (Bara 2020). They focus on the development of cutting-edge scientific methods to explore and test the limits of prediction on a rare and hard target – the outbreak of civil war. The field shares a positivist paradigm of research that integrates mathematical models and sophisticated computational techniques. The predictive conflict researchers insist that there is a fundamental distinction between explanation and prediction. From an analytical point of view, this makes sense since risk factors identified in past conflict may fail to predict in unseen new data. Consequently, out-of-sample model validation is at the heart of the standard procedure they develop. In principle, their work is relevant for government and society precisely because of its focus on methodological expertise and the fact that all their predictions, tools, and data are made transparent and verifiable by peers. Yet so far the work has received only little attention in policy circles, lacking direct policy relevance.

One of the key trends observable in the empirical chapters is the growing role of private actors in the production of predictive knowledge. In the context of growing concern about a newly emerging bio-weapons threat and almost no publicly accessible knowledge about potential capabilities and motivations of state competitors, public actors like the Pentagon and NATO are increasingly turning to science fiction in thinking about the potential political and military impact of transformative technologies in the life sciences. Novels and films, as Chapter 10 by Filippa Lentzos, Jean-Baptiste Gouyon, and Brian Balmer demonstrates (Lentzos *et al*. 2020), can act as a particularly accessible source of imagination, because they emphasize the human rather than the technological dimension of emerging threats and focus on possible non-linear dynamics. In highly indeterminate contexts with little available data, science fiction may be added as an additional element to the wider process of anticipatory knowledge creation by key public actors.

The central role of fiction for decisions made under uncertainty is confirmed by Katzenstein and Nelson in their analysis of financial market governance failure in the run-up to the 2008 financial crisis (Chapter 9). Prior to the crisis, private rating agencies played a key role in the promise of self-regulating global financial markets. Market participants and policy-makers assumed that the new securitization technologies provided by rating agencies would domesticate uncertainty into manageable risk and make government regulation largely obsolete. Although the crisis proved the agencies to be spectacularly wrong, they kept their central role. The near melt-down of financial markets, Katzenstein and Nelson point out, reminded market participants and policy-makers that financial markets are ambiguous, characterized by risk *and* uncertainty, and that in the face of epistemic uncertainty they would need to rely on social conventions and institutions to stabilize markets. Thus, central bankers not only calculate risk, but

also influence expectations and practices of market players exercising social power. Financial market dynamics are in reality deeply intertwined with social conventions and institutions (Katzenstein and Nelson 2020).

Private actors and their predictive tools play an increasing role in the day-to-day management of many other complex social problems. As Matthias Leese shows in Chapter 13, the growing computing power and the algorithmic exploitation of ever bigger data-pools have the potential to fundamentally transform the relationship between the police and the future. Yet there is a certain mismatch between the promises of the industry that develops and provides the software, and the practices of the police forces that use the software to collect and analyse crime data and organize their work accordingly. Whereas the industry promises near-repeat modelling that would allow to catch a criminal before the crime, institutional structures, organizational routines, and limited financial and personal resources severely limit the practical flexibility of situational planning and operational adjustment. Predictive policing, Leese argues, should not just be seen as a technological tool, but rather as a socio-technical assemblage through which societies address the future in the everyday production of security (Leese 2020).

Public actors using their intelligence agencies produce their own predictive knowledge both at the national level and at the intergovernmental level and within international organizations like the WHO. In Chapter 12 Jonas Schneider discusses the case of the US government that mandated its intelligence agencies during the Cold War with the impossible task of assessing and predicting the global spread of nuclear weapons. The US agencies tended to overestimate nuclear proliferation and, according to Schneider, this reflected the way they dealt with uncertainty. Lacking information about potential proliferators' intent and more generally about domestic and international demand-side factors, they placed too much emphasis on overall supply-trends and a given state's technical capability to build the bomb. Moreover, the fact that both the producer and the consumer of the future knowledge were part of the same governmental bureaucracy did not eliminate the tension between the two. Decision-makers wanted unequivocal claims, Schneider reminds us, while analysts, well aware of the perils of predicting state behaviour under huge uncertainty, generally preferred qualifying language – confirming an enduring tension between policy-makers and their intelligence services (Schneider 2020; also Jervis 2010).

Unprecedented progress in digital health technologies and artificial intelligence in combination with the accumulation of massive amounts of health-related data have driven what Ulla Jasper in Chapter 8 calls a policy paradigm of 'anticipative medicalization'. Coming together in the WHO, member states decided to establish an all-risk surveillance system for the real-time detection of emerging disease events that committed all members to install a state-wide monitoring system in order to collect national data that would – after aggregation and analysis at the WHO – be integrated into WHO regulation and global health policy-making. Jasper narrates how the current precautionary governance system of global health risks was co-constituted by these new technologies

and social, economic, and political interests of actors that pushed for stronger and broader global communicable disease control. Yet she cautions that despite the current widespread technological optimism many fundamental ethical and politico-regulatory questions remain unresolved.

The consequences for politics, society, and science

After establishing the wide variance in the 'who' and 'how' of integrating future knowledge in public policy and (global) governance we will discuss some of the consequences of decision-making in a world of risk *and* uncertainty for politics, society, and science. Once again we will proceed in three steps, highlighting *first* that predictions indeed do have major political consequences and at least to some degree do co-create the future, sometimes in unintended ways; *second* that they do affect and change power structures in society as well as in politics, raising new complex ethical and political issues; and *third* that we can observe some of the complex feedback loops between politics and science outlined in the preceding sections.

Predictions, once integrated into decision-making and acted upon, can have a major impact on national and international policy and practice. Moreover, the intensities of the impacts are not necessarily directly correlated with the accuracies or inaccuracies of the predictions. Only the future will tell how accurate they were and in the meantime they may change the future to some degree regardless of their accuracy. Probably the best example of the great consequences predictions can have for a country's foreign policy and for the evolution of the global order is the case of the US intelligence services' regular assessment of what the global nuclear landscape would look like in five to ten years. As Jonas Schneider shows in Chapter 12, the pessimistic and alarmist forecasts played a crucial role in legitimizing a shift in US policy from nuclear sharing to nuclear nonproliferation (Schneider 2020); a shift that turned out to be crucial for establishing and strengthening the global nonproliferation regime, decisively shaping the future global nuclear order (Wenger and Horovitz 2018). Paradoxically, the biggest shifts in US policy occurred at the very time when the intelligence estimates were the least alarmist and some even under-predicted nuclear proliferation. Policy-makers simply disregarded the non-alarmist estimates, using the older alarmism to legitimize the new policy.

In their analysis of climate adaptation-decision-making, Lemos and Klenk show how the integration of scientific uncertainty in multi-level governance systems can complicate decision-making and at times can lead to political blockade (Chapter 7: Lemos and Klenk 2020). They present a case from the US heartland, in which the local level successfully mobilized adaption capacities and developed credible adaption plans. Since these local initiatives were, however, not well-aligned with policy-making at the regional and national levels, local actors received only little financial support and the good plans remained a paper tiger. Another case highlights how vulnerability assessments can have unintended consequences. The vulnerability maps were co-produced by multiple

stakeholders, but once they were ready for publication the question arose who would be liable for the likely changes in property values following their official release. Predictive uncertainty in vulnerability maps can translate into legal uncertainty as regards the question of who is responsible for the production of risky knowledge. A third case – already leading over into the implication of prediction for democratic politics – underlines how the inclusion of scientific prediction in decision-making can facilitate a technocratic kind of policy-making. The inclusion of climate models in local climate adaptation policy-making increased the role of technocrats that gained a disproportionate influence over distributional outcomes.

The integration of future knowledge into public policy and governance offers opportunities for redistributing political power and social influence at the national and international level, posing new ethical and political dilemmas. The establishment of a global health surveillance system in effect prioritized disease control over other global health policy goals, Ursula Jasper argues in Chapter 8 (Jasper 2020). With its emphasis on early warning, quick response, preparedness and resilience, the global health governance system reflected the precautionary policy approach of the industrialized states, while the key interest of the developing countries – like access to universal healthcare and pharmaceutical products – were marginalized. The shift from a curative and remedial approach to individual health to a new approach that emphasizes predictive genetic diagnostics and individual prevention also poses new ethical and socio-political dilemmas. The predictive euphoria, Jasper notes, may create a slippery slope that can lead to uninsurable individuals, genetic discrimination, and eugenic selection.

The growing role of private actors in prediction is another trend that has the potential to affect politics and society in major ways. Analysing the case of predictive policing, Leese demonstrates in Chapter 13 that, on the one hand, society and cultural values shape how the predictive software is used. While commercial software providers and police departments in the US use the new technical tools for individualized crime prediction that focuses on a potential offender's risk profile, most European providers and police forces implement predictive policing tools that foreground the place and time of future criminal activity. On the other hand, however, the integration of algorithmic software developed in industry may increase the dependence of public actors on the private sectors in the fulfilment of critical state functions in the area of security and safety. Moreover, the integration of proprietary software in the day-to-day operations of governmental agencies raises the question of how public actors can ensure that they know what the software does and independently evaluate its transparency, fairness, and security (Leese 2020).

Finally, the interaction between science and politics can work through complex feedback loops that affect science and society in unexpected ways. Two examples emerge from the empirical chapters of this book. First, Katzenstein and Nelson show how the models of economists not only analyse markets, but alter them. The rationalist ideas of economists are assimilated by market participants

and policy-makers and – against better knowledge – integrated in both governmental regulations and the operation of the financial system. Thus, unwillingly, economists participate in a social performance out of which emerges a fictional future world. Economists, Katzenstein and Nelson conclude, should put the social back into the science that analyses financial markets (Katzenstein and Nelson 2020).

Second, while the interaction between climate science and climate policy provides object lessons about backlash and the risk of politicization of science, staying aloof of society and politics, as in the case of predictive conflict researchers, comes with costs as well. Both science and politics miss out on an opportunity to jointly contribute to better anticipation and early warning of at least some short-term violent outcomes. For instance, academics could more systematically explore policy-relevant predictions on specific risk factors that could be changed by policy or model and evaluate alternative policy interventions that would allow public actors to choose more systematically between different policy measures. Yet as long as there is only limited interaction with the policy world, public policy will rely on predictions provided by political risk analysis firms, NGO's or governmental units. In most of these cases, data is confidential and the methods of prediction are not made transparent. Conversely, the research field has not reflected on how academic civil war prediction can and should influence policy-making and what consequences this may have for politics, society, and science.

Conclusion

The politics and science of the future evolve together and every new era comes with its specific promises and pitfalls in anticipating and planning for the future. In this concluding section we look into current and future challenges of thinking about the future at the intersection of politics and academia. We do this going back to the four context factors introduced at the beginning of this concluding chapter (see Figure 14.1). We end our discussion of the complex interactions and feedback-loops between the politics and science of the future with a short reflection on some of the key trends in these four areas.

Predictive imagination emerges in a specific cultural, institutional, and historical setting. Most methods and practices of prevision discussed in this book emerged in a Western context – other cultural contexts have their own repertoire of dealing with the future. Yet as alternative visions of the future are increasingly negotiated at the global level – between Western and non-Western future visions – and will potentially be integrated into global politics and governance, understanding how different cultures think about the future becomes more important. The comparative relationship of varying cultures with the future thus deserves further study, as do the questions in which visions of order (in an anarchic world or in institutions) and how (through cooperation or conflict) future visions will be negotiated at the international level, especially between great powers and large societies.

Yet the question of who and where future visions are negotiated is relevant at the level of domestic politics too, precisely because the fragmentation of authority and accountability in addressing complex, interconnected, and transnational social challenges represents one of the key challenges for government and governance. State, society, and industry increasingly share responsibility in the day-to-day governance of technology, markets, health, and even in such fields as disaster preparedness, as the shift to precautionary politics and the rise of the concept of resilience across many policy fields demonstrate. The move to precautionary politics and a more networked approach to governance can be observed at both ends of the predicted time horizon, the very long one in the context of climate change and the very short one in the context of adapting to rapidly emerging technologies.

The demand for policy-relevant work in general and scientifically robust future-oriented knowledge in particular will keep rising – but the demand will likely shift from a case-by-case request of policy-makers to a more continuous collaboration, as the new predictive technologies are becoming more deeply integrated in the everyday operation of governmental bureaucracies and the day-to-day management of many public issues. The interconnectedness between ever denser socio-technical systems will grow rapidly, as the digitalization of society, economy, and politics takes its course. Society will become increasingly dependent on and interwoven with a rapidly expanding cyberspace, which in turn will be interlinked with space-based and other newly emerging technologies in the fields of quantum computing and artificial intelligence. Because these technologies will in large part be developed by global technology firms – and not public universities – the role of the private sector in assembling future knowledge will keep growing as well (Dunn Cavelty and Wenger 2019). Yet this also means that a growing portion of future knowledge will fall under trade secrets and non-disclosure agreements and lack transparency and accountability as regards epistemological premise, method, and data.

The historical shift away from a public model of prediction to a private model of prediction is linked to the growing computing power and the algorithmic exploitation of big data that come with the promise of controlling and managing the future at an unprecedented scale and speed. Yet it is problematic for society and democracy if the development and application of these new AI tools is dominated by a few global technology firms – that are operating under a steep safety–performance trade-off – and a few great powers – that perceive these technologies as a strategic resource (Dafoe 2018). In short, the dependence of the public sector on private providers of predictive tools and knowledge is increasing. As a corollary, there is a growing need for systematic and transparent evaluation of these tools and, especially in a democratic setting, governments are expected to ensure that these tools will be used in a responsible, inclusive, and peaceful way (Fischer and Wenger 2019). In addition, the growing role of private providers of scientific knowledge about the future also affects anticipatory practices, because with their applied and problem-centred

outlook and flexible collaborative style they are well positioned to contribute to transdisciplinary modes of knowledge creation.

Academia and the traditional university system – based on a disciplinary organization of knowledge production and perceived as autonomous of society and politics – are changing too, shaping and shaped by the rapid transformation of society, economy, and politics. If scientists in universities want to become more policy-relevant, they must become more accustomed to work in interdisciplinary settings, because future knowledge is inherently multi-disciplinary. For example, more research at the intersections of computer science, mathematics, economic, and political science is needed in order to develop sustainable socio-technical systems. In addition, universities need to expand their policy-relevant tool box and define how they want to work in transdisciplinary settings at the intersection of basic and applied research, where multiple producers and consumers of future knowledge come together. It is in the interest of science and society that public universities are not marginalized in foreseeing and planning for what is to come.

Politics and science in a democracy depend on each other, especially as regards assembling and integrating future knowledge into policy and governance. The key contribution of academia is the creation of public, transparent, and peer-reviewed future-oriented knowledge. The key contribution of politics is the design of a deliberative and forward-looking mechanism to integrate this knowledge into public policy and practice. Together, they must choose the method and anticipatory practice so that they fit the object and political purpose of prevision; map, assess, and explore newly emerging predictive tools (Dafoe 2018); and join forces in science diplomacy as a means to build bridges between societies and ensure that the long-term development of these tools is transparent, inclusive, responsible, and sustainable (Fischer and Wenger 2019).

References

Adam, B. (2010) ‘History of the Future: Paradoxes and Challenges’, *Rethinking History* 14(3): 361–78.

Akin, H. and Scheufele, D. A. (2017) ‘Overview of the Science of Science Communication’, in K. H. Jamieson, D. M. Kahan and D. A. Scheufele (eds) *The Oxford Handbook of the Science of Science Communication*, Oxford: Oxford University Press, 25–34.

Aradau, C. and van Munster, R. (2007) ‘Governing Terrorism through Risk: Taking Precautions, (Un)Knowing the Future’, *European Journal of International Relations* 13(1): 89–115.

Assmann, A. (2013) *Ist die Zeit aus den Fugen? Aufstieg und Fall des Zeitregimes der Moderne*, München: Carl Hanser Verlag.

Bara, C. (2020) ‘Forecasting Civil War and Political Violence’, in A. Wenger, U. Jasper and M. Dunn Cavelty (eds) *Probing and Governing the Future: The Politics and Science of Prevision*, London and New York: Routledge, 177–93.

Bauer, H. and Brighi, E. (2009) ‘Introducing Pragmatism to International Relations’, in H. Bauer and E. Brighi (eds) *Pragmatism in International Relations*, London and New York: Routledge.

Bell, D. (1964) 'Twelve Modes of Prediction: A Preliminary Sorting of Approaches in the Social Sciences', *Daedalus* 93: 845–80.

Breslin, S. (2011) 'The "China Model" and the Global Crisis: From Friedrich List to a Chinese Mode of Governance?', *International Affairs* 87(6): 1323–43.

Buchanan, B. and Miller, T. (2017) *Machine Learning for Policymakers: What It Is and Why It Matters*, The Cyber Security Project, Cambridge, MA: Belfer Center for Science and International Affairs, Harvard Kennedy School.

Chilvers, J. (2013) 'Reflexive Engagement? Actors, Learning, and Reflexivity in Public Dialogue on Science and Technology', *Science Communication* 35: 283–310.

Dafoe, A. (2018) *AI Governance: A Research Agenda*, Governance of AI Program, Oxford: Future of Humanity Institute, University of Oxford.

Dewey, J. (1954) *The Public and Its Problems*, Chicago: Swallow Press.

Doubleday, R. (2008) 'Ethical Codes and Scientific Norms: The Role of Communication in Maintaining the Social Contract for Science', in R. Holliman, J. Thomas, S. Smidt, E. Scanlon and E. Whitelegg (eds) *Practising Science Communication in the Information Age: Theorising Professional Practices*, Oxford: Oxford University Press, 19–34.

Dunn Cavelty, M. (2020) 'From Predicting to Forecasting: Uncertainties, Scenarios and their (Un)Intended Side Effects', in A. Wenger, U. Jasper and M. Dunn Cavelty (eds) *Probing and Governing the Future: The Politics and Science of Prevision*, London and New York: Routledge, 89–103.

Dunn Cavelty, M. and Wenger, A. (2019) 'Cyber Security Meets Security Politics: Complex Technology, Fragmented Politics, and Networked Science', *Contemporary Security Policy* 41(1): 5–32.

Dusdal, J. (2017) *Welche Organisationsformen produzieren Wissenschaft? Expansion, Vielfalt und Kooperation im deutschen Hochschul- und Wissenschaftssystem im globalen Kontext, 1900–2010*, Doctorate Thesis, Luxembourg: University of Luxembourg.

Edenhofer, O. and Kowarsch, M. (2015) 'Cartography of Pathways: A New Model for Environmental Policy Assessments', *Environmental Science and Policy* 51: 56–64.

Edwards, P. (2010) *A Vast Machine: Computer Models, Climate Data, and the Politics of Global Warming*, Cambridge, MA: MIT Press.

Ewald, F. (2002) 'The Return of Descartes's Malicious Demon: An Outline of a Philosophy of Precaution', in T. Baker and J. Simon (eds) *Embracing Risk*, Chicago: Chicago University Press, 273–301.

Ferdinand, P. (2016) 'Westward Ho: The China Dream and "One Belt, One Road": Chinese Foreign Policy under Xi Jinping', *International Affairs* 92(4): 941–57.

Fischer, S. C. and Wenger, A. (2019) 'A Neutral Hub for AI Research', *CSS Policy Perspectives 7*(2), Zurich: Center for Security Studies (CSS).

Fukuyama, F. (1992) *The End of History and the Last Man*, New York: Free Press.

Gavin, F. J. (2020) 'Thinking Historically: A Guide for Policy', in A. Wenger, U. Jasper and M. Dunn Cavelty (eds) *Probing and Governing the Future: The Politics and Science of Prevision*, London and New York: Routledge, 73–88.

Gibbons, M., Limoges, C., Nowotny, H., Schwartzman, S., Scott, P. and Trow, M. (1994) *The New Production of Knowledge: The Dynamics of Science and Research in Contemporary Societies*, London: Sage.

Grunwald, A. (2014) 'The Hermeneutic Side of Responsible Research and Innovation', *Journal of Responsible Innovation* 1: 274–91.

Hellmann, G. (2020) 'How to Know the Future – and the Past (and How Not): A Pragmatist Perspective on Foresight and Hindsight', in A. Wenger, U. Jasper and M. Dunn Cavelty

(eds) *Probing and Governing the Future: The Politics and Science of Prevision*, London and New York: Routledge, 45–62.

Hölscher, L. (ed.) (2017) *Die Zukunft des 20. Jahrhunderts: Dimensionen einer historischen Zukunftsforschung*, Frankfurt/New York: Campus Verlag.

Horowitz, C. (2020) 'Future Thinking and Cognitive Distortions: Key Questions that Guide Forecasting Processes', in A. Wenger, U. Jasper and M. Dunn Cavelty (eds) *Probing and Governing the Future: The Politics and Science of Prevision*, London and New York: Routledge, 63–72.

Jacob, M. and Hellström, T. (2000) *The Future of Knowledge Production in the Academy*, Buckingham: The Society for Research into Higher Education and Open University Press.

Jasanoff, S. (2015) 'Imagined and Invented Worlds', in S. Jasanoff and S.-H. Kim (eds) *Dreamscapes of Modernity: Sociotechnical Imaginaries and the Fabrication of Power*, Chicago: Chicago University Press.

Jasanoff, S. (2020) 'Imagined Worlds: The Politics of Future-Making in the 21st Century', in A. Wenger, U. Jasper and M. Dunn Cavelty (eds) *Probing and Governing the Future: The Politics and Science of Prevision*, London and New York: Routledge, 27–44.

Jasanoff, S. and Kim, S.-H. (eds) (2015) *Dreamscapes of Modernity: Sociotechnical Imaginaries and the Fabrication of Power*, Chicago: Chicago University Press.

Jasper, U. (2020) 'The Anticipative Medicalization of Life: Governing Future Risk and Uncertainty in (Global) Health', in A. Wenger, U. Jasper and M. Dunn Cavelty (eds) *Probing and Governing the Future: The Politics and Science of Prevision*, London and New York: Routledge, 122–40.

Jervis, R. (2010) 'Why Intelligence and Policymakers Clash', *Political Science Quarterly* 125(2): 185–204.

Jones, L. and Zeng, J. (2019) 'Understanding China's "Belt and Road Initiative": Beyond "Grand Strategy" to a State Transformation Analysis', *Third World Quarterly* 40(8): 1415–39.

Katzenstein, P. J. and Nelson, S. C. (2020) 'Crisis, What Crisis? Uncertainty, Risk, and Financial Markets', in A. Wenger, U. Jasper and M. Dunn Cavelty (eds) *Probing and Governing the Future: The Politics and Science of Prevision*, London and New York: Routledge, 141–57.

Klinke, A. and Renn, O. (2002) 'A New Approach to Risk Evaluation and Management: Risk-Based, Precaution-Bases, and Discourse-Based Strategies', *Risk Analysis* 22(6): 1071–94.

Leese, M. (2020) '"We Do That Once per Day": Cyclical Futures and Institutional Ponderousness in Predictive Policing', in A. Wenger, U. Jasper and M. Dunn Cavelty (eds) *Probing and Governing the Future: The Politics and Science of Prevision*, London and New York: Routledge, 213–25.

Lemos, M. C. and Klenk, N. (2020) 'Uncertainty and Precariousness at the Policy–Science Interface: Three Cases of Climate-Driven Adaptation', in A. Wenger, U. Jasper and M. Dunn Cavelty (eds) *Probing and Governing the Future: The Politics and Science of Prevision*, London and New York: Routledge, 107–21.

Lentzos, F., Gouyon, J.-B. and Balmer, B. (2020) 'Imagining Future Biothreats: The Role of Popular Culture', in A. Wenger, U. Jasper and M. Dunn Cavelty (eds) *Probing and Governing the Future: The Politics and Science of Prevision*, London and New York: Routledge, 158–76.

Li, Y., Chen, J. and Feng, L. (2012) 'Dealing with Uncertainty: A Survey of Theories and Practices', *IEEE Transactions on Knowledge and Data Engineering 25*(11): 2463–82.

Maasen, S. and Weingart, P. (2005) 'What's New in Scientific Advice to Politics? Introductory Essay', in S. Maasen and P. Weingart (eds) *Democratization of Expertise? Exploring Novel Forms of Scientific Advice in Political Decision-Making*, Dordrecht: Springer, 1–19.

Maull, H. W. (ed.) (2018) *The Rise and Decline of the Post-Cold War International Order*, Oxford: Oxford University Press.

McLean, C., Patterson, A. and Williams, J. (2009) 'Risk Assessment, Policy-Making and the Limits of Knowledge: The Precautionary Principle and International Relations', *International Relations* 23(4): 548–66.

Mische, A. (2009) 'Projects and Possibilities: Researching Futures in Action', *Sociological Forum* 24(3): 694–704.

Nowotny, H., Scott, P. and Gibbons, M. (2001) *Re-Thinking Science. Knowledge and the Public in an Age of Uncertainty*, Cambridge: Polity.

Pielke, R. (2007) *The Honest Broker: Making Sense of Science in Policy and Politics*, Cambridge: Cambridge University Press.

Schimank, U. (2012) 'Wissenschaft als gesellschaftliches Teilsystem', in S. Maasen, M. Kaiser, M. Reinhart and B. Sutter (eds) *Handbuch Wissenschaftssoziologie*, Wiesbaden: Springer VS, 113–23.

Schneider, J. (2020) 'Predicting Nuclear Weapons Proliferation', in A. Wenger, U. Jasper and M. Dunn Cavelty (eds) *Probing and Governing the Future: The Politics and Science of Prevision*, London and New York: Routledge, 194–212.

Simandan, D. (2018) 'Wisdom and Foresight in Chinese Thought: Sensing the Immediate Future', *Journal of Futures Studies*, 22(3): 35–50.

Snowden, D. (2015) *Cognitive Edge: Making Sense of Complexity*, Oxford: Butterworth-Heinemann.

Wenger, A. and Horovitz, L. (2018) 'Nuclear Technology and Political Power in the Making of the Nuclear Order' in R. Popp, L. Horovitz and A. Wenger (eds) *Negotiating the Nuclear Non-Proliferation Treaty: Origins of the Nuclear Order*, New York: Routledge, 223–39.

Wenger, A., Jasper, U. and Dunn Cavelty, M. (2020) 'The Politics and Science of the Future: Assembling Future Knowledge and Integrating It into Public Policy and Governance', in A. Wenger, U. Jasper and M. Dunn Cavelty (eds) *Probing and Governing the Future: The Politics and Science of Prevision*, London and New York: Routledge, 3–23.

Westad, O. A. (2020) 'Legacies of the Past', in D. Shambaugh (ed.) *China and the World*, New York: Oxford University Press, 25–36.

Zeng, J. (2019) 'Chinese Views of Global Economic Governance', *Third World Quarterly* 40(3): 578–94.

Zhao, S. (2010) 'The China Model: Can It Replace the Western Model of Modernization?', *Journal of Contemporary China* 19(65): 419–36.

Zheng, W. (2012) *Never Forget National Humiliation: Historical Memory in Chinese Politics and Foreign Relations*, New York: Columbia University Press.

Index

Page numbers in **bold** denote tables, those in *italics* denote figures.