On the Notion of 'Extremes'

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Humanity is confronted by and attracted to extremes. Extreme events shape our thinking, feeling, and actions, and echo in our politics, media, literature, and science. We often associate extremes with crises, disasters, and risks that are to be averted. Yet extremes also have the potential to lead us towards new horizons.

Featuring essays arising from the 2017 Darwin College Lectures, this volume explores a spectrum of 'extreme' events, from the 2008 financial crisis, the election of President Trump, the rise of populism, and the Brexit referendum, to the Syrian war and climate change. At the same time, the essays celebrate 'extreme' achievements in the realms of human health, ocean exploration, and cosmological discoveries, shedding light on extremes in the past, the present, and the future.

In this preface, we explore the notion of extremes by reflecting on the individual contributions to the volume. These essays challenge our understanding of what is 'normal', what is exceptional, and what 'extreme' really is by illustrating how extremes are the manifestation of what we do and what we perceive, and are at the heart of many issues we cope with. Pulling together the core topics of the book, we show how the notion of extremes radiates into different subject areas, and the way in which it can – and cannot – help us make sense of the world.

Three fundamental questions link the essays.

The first is why there is such a human fixation on (if not an obsession with) and such widespread attention to extremes: from setting records to attributing superlatives, from climbing the highest mountain to exploring the poles, from driving the fastest car to baking the best cake, from collecting the rarest stamp to catching the biggest fish, from finding the oldest fossil to detecting outliers within the realm of machine learning. We, the editors, with our respective interests in economic and environmental crises,

financial and nuclear meltdowns, historical and future dimensions of risks, admittedly share some of the (academic) excitement around extremes.

This fascination permeates this volume. For instance, driven by excitement and determination, Roz Savage spent up to five months alone at sea, rowing for twelve hours a day. As the first (and so far, only) woman ever to do so, she discusses the challenges of rowing solo around the globe – and the motivational force of extremes – in her essay 'Extreme Rowing'. Our fixation with extremes also makes them a magnet for media attention. In her chapter, Lyse Doucet shares her experiences of reporting on 'Extremes of War' as the BBC's Chief International Correspondent – most recently from Syria. The sometimes fascinating, sometimes frightening 'appeal of extremes' as a challenge, a source of learning, and sometimes as an object of voyeurism can possibly be attributed to human psychology and evolution. So, be it by instinct or by reason, extremes attract our attention – but what is the merit?

The second, perhaps more important question, therefore, revolves around the value of extremes for human knowledge. What is the epistemic value, the intellectual advantage of experiencing and understanding the 'extreme', the anomalous, over the 'normal' and the mundane? Can a dichotomy of 'extreme' versus 'mean' be a useful way of looking at the world? A basic hypothesis about our attraction to extremes could be that we think about them assuming a kind of polarity, attempting to use them as starting points for locating the 'normal' in the middle. However, a focus on fringe or marginal phenomena can also distract from and impair the view of the ordinary, in other words, what seems to matter most, most of the time. Astronomer Royal Martin Rees, who gave the first-ever Darwin Lecture in 1986, suggests that advances in astronomy – the oldest numerical science – offer a clue. Summarising centuries of discovery, and looking into the future, Rees posits,

> *Astronomers are always specially interested in the most 'extreme' phenomena in the cosmos, because it is through studying these that we are most likely to learn something fundamentally new. . . There are three great frontiers in science: the very big, the very small, and the very complex.*[1]

In other words, by looking to the edges of what we know, what we can observe, and what we can imagine, we are more likely to discover the fundamental, the new, and the surprises. Often it is in the minimal and maximal limits that our best ideas are tested – and found. As extremes test our understanding, they can cause a crisis of an academic discipline, expose flaws in a theory, and eventually trigger the paradigm shifts that

our knowledge systems irregularly undergo. In this way, extremes can constitute 'anomalies', as referred to in the context of scientific revolutions by philosopher of science Thomas Kuhn.[2] Their observation as new phenomena, or construction as novel ideas, has the potential to challenge existing worldviews. Similarly, as Joseph Overton has argued, positions previously conceived as 'extreme' can be, gradually or suddenly, accepted and embraced as 'normal' within public discourse, or in the process and wake of social, economic, and political changes.

Intellectual history, the history of ideas, and the history of science offer abundant examples of how extremes test our deepest-held knowledge. In some cases, resistance to extremes can prevail, e.g. in the case of religious extremism, and, to the contrary, cause pushback and backlash, often towards the opposite 'extreme'. Against this backdrop, Matthew Goodwin's essay 'Extreme Politics' explores the recent resurgence of the far right in Europe. In other cases, formerly 'extreme' positions can become a 'new normal', such as the Lutheran reformation, Copernican heliocentrism, or Wegener's theory of plate tectonics. As another example, in her essay 'Extreme Longevity', gerontologist Sarah Harper explores the profound economic and social consequences that follow from the fact that half of Europeans born today will live to be a hundred years old, and whether there is a maximum life span for any human being. In situations such as this, it is impossible to uphold the status quo ante or restore the status quo post in a way identical to the previous state of affairs. That is, as extreme events generate 'new normals', old patterns are disrupted, and new patterns emerge. Thus, in the process of anomaly-driven shifts, insights, and theory redesigns, extremes have the potential to open the doors to understanding and accepting what we would have never considered valid before.

Even where experiencing, achieving, or studying extremes does not lead to 'fundamentally new' insights, it can provide impetus to incremental adjustments of our existing models of the world. This is especially the case where we understand extremes as lying quantitatively (among a distribution of values) or qualitatively (on a gradual spectrum), instead of classifying them as categorical extremes entirely beyond previous knowledge systems. Wherever the 'merely gradual' or 'merely quantitative' extremes can be accommodated, there is a tendency for them to be subsumed by existing frameworks, simply by moving the metaphorical goalposts between the possible and the impossible. However, insofar as

extremes constitute categorical 'outliers', i.e. rare objects causing analytical problems, they are opportunities not only to shift the known limits of sample maxima and sample minima, but also to significantly redefine what constitutes the average and what we henceforth consider as 'normal'.

While in statistical distributions an extreme value can be referred to as a maximum or minimum upwards of four sigmas (σ), Nassim Nicholas Taleb's essay 'Probability, Risk, and Extremes' demonstrates the shortcomings of conventional statistical tools. Taleb demonstrates how supposedly robust statistics are not robust at all, how frequency-based forecasting fails, and how past averages misrepresent future ones. So, regardless of how we conceptually understand deviations, outliers, exceptions, novelties, and other 'abnormal' phenomena as extremes, we can acknowledge their potential and their significance in challenging us, generating new ideas, and stress-testing existing ones. Thus, there is significant scholarly merit in treating them as objects of study, as keys to unlock the treasure chests of knowledge.

Finally, the essays address, explicitly or implicitly, and each in its own way, whether we are living in an age of extremes. This is a compelling proposition when thinking about the unprecedented number of humans on planet Earth and their irreversible footprint on the biosphere. Albeit, words of caution might be warranted. What goes without saying is that ruling out observational and interpretational errors, and awareness of anthropic bias, is essential before jumping to the conclusion that we are observing an 'extreme' phenomenon. To this end, David Runciman's essay 'Dealing with Extremism' teases out the important differences between political extremists and conspiracy theorists: while the experience of governing tends to soften the edges of extremists, conspiracy theorists become hardened in their views, turning conspiracy theories into governing philosophies. Not only in the political sphere, we are also well advised to remain conscious of who gets to define ideas as 'extreme' and to whose benefit this is. Normatively, we do not necessarily know an 'extreme' when we see one as power relationships tend to influence anomaly construction.

Most importantly, therefore, the essays in this book should remind us that the notion of the 'extreme' is fundamentally relative, for the classification or declaration of anything as 'extreme' is context-sensitive and ephemeral: tied to a particular time, place, and perspective. Because yesterday's extremes all too often become today's 'normal', they are contingent on their (explicit and implicit) frames of reference, scale, scope, and

limitations of observation. For example, in Emily Shuckburgh's essay 'Extreme Weather' on the science underlying the causes and implications of climate change, we learn that 2016 was the warmest year on Earth since records began, the second warmest being 2015 and the third warmest 2014. Such comparisons are inherently contingent on the timeframe of our records, in this case excluding non-anthropogenic climatic extremes (around 55.5 million years ago temperatures were possibly 8°C warmer globally than today) and our, in all likelihood, hotter future.

The depth of the past, the vastness of the cosmos, the uncertainties of the present, and the unknowns of the future are humbling, and, in conclusion, must caution us to deem anything 'extreme'. Such attributions should therefore only be made, and read, in quotation marks. Andrew Fabian's discussion of the life and death of stars in 'Extremes of Power in the Universe' takes us to the limits of human imagination and thereby perfectly illustrates this point. Across historical, archaeological, palaeontological, geological, or astronomical scales of time, and across space (which, according to multiverse theory, could span across an infinite number of universes), indeed, it is impossible to refer to anything as 'extreme' with certainty.

In summary, the notion of 'extremes' appears to be of value in three ways: when it drives our curiosity and aspiration, when it helps us understand the world, and when it makes us realise our own humility.

'Critical rationalism' and the concept of empirical falsification, famously advanced by Karl Popper, the philosopher of science often compared against Kuhn (and formerly an Honorary Fellow of Darwin College, as is Rees today), suggest that, in the empirical sciences, extremes can never be proved.[3] They can only be falsified by even 'extremer' extremes. English grammar, thus, rather logically, allows higher degrees of the adjective 'extreme'. So as much as extremes remain a mirror of the limitations of their context and time, and of the humility of human knowledge, they should be referred to with caution.

References

1 M. Rees, *Just Six Numbers* (Basic Books, 2000), pp. 35, 159.
2 T. Kuhn, *The Structure of Scientific Revolutions* (University of Chicago Press, 1962).
3 K. Popper, *Logik der Forschung: Zur Erkenntnistheorie der modernen Naturwissenschaft* (Mohr Siebeck, 1934); rewritten as *The Logic of Scientific Discovery* (Hutchinson Education, 1959).