



## Postnormal times revisited



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### ABSTRACT

Postnormal times (PNT) have been characterised by complexity, chaos and contradictions. But PNT theory has come under criticism for (allegedly) suggesting that 'the world has entered an Omega phase', using Alliterative Logic, and being western in nature. This paper answers some of the critics of PNT, provides further evidence of postnormal phenomenon, and examines the current trends that are taking us towards a postnormal 'extended present'. Finally, it explores what PNT implies for futures studies and what it means to 'be postnormal'.

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In 'Welcome to Postnormal Times' (Sardar, 2010), I argued that we are entering an era where complexity, chaos and contradictions will become the dominant themes; and uncertainty and ignorance will increase drastically. The paper was written to mark the end of my fifteen years editorship of *Futures*; and was meant as a summary of what I had learned from careful perusal of hundreds of papers, accepted and rejected, submitted to the journal. A text, Roland Barthes (1967) has written, is a collection of quotations drawn from numerous centres of cultures. 'Welcome to Postnormal Time' is an attempted synthesis of ideas culled from the fabric of foresight and futures studies. Of course, what other futurists make of it, the meaning it imparts, is quite independent of its author: it depends on what the readers read in the text, rather than what I intended to say, what I did or did not say. Nevertheless, I was pleasantly surprised at the reaction and debate the paper stimulated. It generated a special issue of *Futures* on 'Postnormal Times' (Davies, 2011a); and the term itself has gained some currency. Postnormal analysis has now spread from science, where it is well established, to futures studies, political analysis, economic intelligence and architecture and cultural heritage.

Here, I would like to critically engage with some of rejoinders to the paper, attempt to answer some of the questions that have been raised, pin down a few characteristics of the postnormal condition, highlight the postnormal that lurks over the horizon, and explore what it means to 'be postnormal'.

### 1. PNT and its (dis)content

An obvious question, raised numerous times, is: how can we have postnormal when there is no such thing as normal? Anyway, who defines what is normal? Clearly, what may be regarded as normal nowadays is quite different to what was seen

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as normal, say during the mediaeval times, or the colonial period. Once slavery and serfdom was seen as normal; and the colonial subjects were regarded as inferior people and cultures when compared to Europe. Thankfully, we have moved on; or evolved morally. Moreover, what may be seen as normal in one culture may appear as aberration in another. Sadness in one culture may be regarded as normal, while another may classify it as ‘depression’ needing clinical intervention. Thus, ‘normal’ can have a variety of meanings, something psychologists know well. The opposite of normal is not postnormal but abnormal.

In postnormal analysis, we take normal to be that which is frequently encountered: what is accepted as the dominant way of being, doing and knowing, conventionally seen as the standard, dictated by convention and tradition, backed by disciplinary structures and scholarship and what we are able to predict and control. The normal is thus located in the well-established modes of thought and behaviour: modernity, postmodernism, predatory capitalism, market fundamentalism, hierarchical structures of society, institutions and organisations, standard scientific procedures, recognised academic disciplines such as economics and political science as well as disciplinary structures, top down politics, broken government, polluting industries, runaway technology, marginalisation of the vast swathes of humanity, xenophobia, racism and misogyny, unjust social and political policies, scientism, and everything else that has shaped and defined the ‘modern world’.

It is the primary contention of postnormal times (PNT) theory that in the current epoch, when, as the formula developed in postnormal science discourse states, ‘facts are uncertain, values in dispute, stakes high, and decisions urgent’ (Ravetz & Funtowicz, 1999), the accepted normal does not work. The basic concepts and assumptions of normality, such as progress, modernisation, growth, development, and efficiency are becoming dangerously obsolete (Sardar, 2010). In fact, the normal has now become the domain of old, dying axioms, thesis, conventions and canons. That there is something profoundly wrong with today’s world, that we are heading towards a ‘paradigm shift’, is fast becoming a common argument and position. James Galbraith simply describes it as the *End of Normal* (2014), while Michael Harris laments the *The End of Absence* (2014). ‘The “signals” that are being constantly generated within the global system’, Richard Slaughter notes, amount to *The Biggest Wakeup Call in History* (Slaughter, 2011). The ‘implicit calculus’ or earlier periods has now become irrelevant, argues Henry Kissinger. The changes that are now occurring are rapid and instantaneous and ‘draw humanity into regions hitherto unexplained, indeed unconceived’ (Kissinger, 2014, p. 343). According to Ulrich Gehmann, we are living in ‘a period of time where new perceptions of the world are emerging, where our relevant ways of conceiving “world” at all, and what it means for us as a whole, is subject to dramatic change’ (Gehmann, 2014, p. 20). Elizabeth Kolbert points out that ‘no creature has altered life on the planet’ in the way humans have; and we are now witnessing a great transformation in the life history of the planet (Kolbert, 2014). Various terms have been coined to describe what we are going through and what we are about to encounter. Ulrich Gehmann and Matin Reiche called it the age of ‘Real Virtuality’. Kolbert describes it as *The Sixth Extinction*. American biologist Michael Soule labels it as the ‘Catastrophozoic’ era (Kolbert, 2014, p. 107). Dutch chemist and noble prize winner, Paul Curtzen (2002), calls it the age of Anthropocene, emphasising the extent of human activities with significant global impact. Peter Allan and Liz Varga have suggested that the period ‘separated by instability, breakdown and collapse of old structures as new features, technologies, variables and characteristics emerge and lead to a new period of qualitative stability’ recall the ‘Long Waves’ of Krondatieff and Schumpeter’s view of waves of ‘creative destruction’ (Allen & Varga, 2014). Others have referred to this era as ‘global weirding’ (Sweeny, 2014) and ‘global swarming’ (Walsh, 2014).

Those of us working on PNT theory have opted for postnormal times for five basic reasons. First, it avoids apocalyptic tones; it is a fairly neutral term, which does not imply that the world system has ‘entered an Omega phase’ as suggested by Gary (2011). In fact, PNT has been deliberately defined as transitory: ‘an in-between period where old orthodoxies are dying, new ones have yet to be born, and very few things seem to make sense’ (Sardar, 2010). ‘Postnormal’ suggests that there is something called the ‘normal’ that preceded it; and there will be a new normal after it. Second, it emphasises agency. What comes after PNT need not be a function of dangers and threats we face; but the new normal, fundamentally different from the old one, can be consciously shaped to be better, saner, more globally and ecologically relevant, more pluralistic, more humane and more peaceful alternative. Third, it emphasizes and focuses our attention on complexity, contradictions and uncertainty that we need to grasp to really understanding how the world is changing. PNT is not a ‘binary metaphor’ either. Indeed, PNT theory insists that (binary) ‘Aristotelian logic is part of the problem and not the answer’; and contends that we urgently need to move beyond binary logic and find new way of thinking and analysing our current problems and new methods for discovering viable solutions. Fourth, PNT has a sound theoretical base, thanks to decades of work on postnormal science, complex emergent systems, and more recent efforts of PNT theory itself. Fifth, theoretical work enables us to develop policies in a plethora of areas and issues to actually navigate postnormal times towards positive futures.

Rakesh Kapoor (2011) has argued that PNT is western theory or concept. Nothing could be further from the truth. It is neither western nor eastern concept; it is simply a theoretical framework which describes and explains our epoch; and like most theories, it ought to have some predictive element, it should be able to envisage the emergence of postnormal phenomenon. As I have written elsewhere,

To talk about a neat division between East and West in a globalised, diverse, interdependent world of common problems and shared human destiny is dangerous and absurd. The boundaries and dividing lines of East and West have not only changed but have become blurred and indistinguishable. There is as much East in the West as there is West in the East. The West cannot continue to perceive the East as inalienably different; the classic tirade against the West that promotes the innocence and vaunts the superiority of the East is meaningless. The potency of the ideas that impelled western imperialism is alive and well and operated by the East within itself, by itself.

Searching out the original miscreant and apportioning blame is a way of continuing the game of implacable opposition, and, thereby, keeping all its necessities – suspicion, military preparedness, manipulation of public opinion, double standards and neglect of pressing human needs – in place. The East has been complicit in the perpetuation of the ethos of binary oppositions. The more the East has unquestioningly sought to appropriate the means of the West, to become modern in an uncritical, slavish manner, the more it demands to be seen as different, the more it has romanticised the superior perfections of its own traditions and values. But no matter how bad things get the East has an immediate escape clause, thanks to the prevailing Kiplingesque understanding of the world. Condemnation of the West for its acts of commission (colonialism, neo-imperialism, political and economic dominance) and omission (failure to understand or appreciate and implacable opposition to the worth of Eastern values and ideas) suffices. It covers all contingencies with complacency and avoids the East's need to examine its own internal shortcomings. East is East and West is West serves everyone. (Sardar, 2013a,b,c)

However, it is true, as Kapoor argues, that the world looks very different 'from the vantage point of a person sitting in New Delhi', or other parts of Asia, such as China and Vietnam. The countries of 'emerging markets' have not enjoyed the level of development enjoyed by the western industrialised countries. But 'the world' is also a deeply interconnected, globalised system. The subsystems of such a planetary system cannot escape the effects of what happens elsewhere in the system. India cannot be immune to global economic shocks; climate change knows no borders; new communication technologies will have as much social, cultural and economic impact on the non-west as the West; emerging developments in synthetic biology will reshape the social fabric of industrialised countries just as much as 'emerging markets'. The very fact that power is now shifting from 'the West' to India, China, Russia and Brazil, and we are moving towards a multi-polar, multi-civilizational world, is a postnormal phenomenon.

What about the argument that we have faced similar hurdles and 'strange times' in the past and, as Sam Cole (2011) states, given our 'sufficient latent reserves of knowledge' and our superior state of evolution, we can solve all our problems and therefore should continue in our present path. This is, as Merry Wyn Davies notes, 'optimism of a monumental nature based on the assumption that because we have managed to solve our problems in the past we will continue to do so forever' (Davies, 2011b). The harsh truth to realise here is that our 'sufficient latent reserves of knowledge', by which I assume Cole means the dominant structures of academic disciplines, are not fit for the purpose of postnormal times. Economics, as it exists today, is a major cause of our problems and a major factor increasing inequality. Development studies have systematically devastated non-western societies for the past several decades. Political science is perhaps the most Eurocentric enterprise ever designed by man (Lummis, 2002). Many issues in science have gone postnormal, from specific disciplines such as climate change and fisheries science, to the structure of scientific activity itself (Ravetz, 2013). As Stephen Healy argues, scientists should now abandon 'ideas of control and management' and 'become the servant of outcomes framed in, primarily, societal terms' (Healy, 2011). The conventional disciplines are part of the problem in that they have led us to our current predicament. While not all knowledge is irrelevant, a great deal of what modernity has produced is steeped in ignorance – the ignorance, for example, of traditional cultures and indigenous ways of knowing and being. In fact, PNT theory postulates three varieties of ignorance: the general ignorance of the complexity of the world around us as well as our knowledge of other cultures and societies; the built-in ignorance within certain problems we face, the answers to which can only be discovered in future times ('known unknowns'); and what in PNT theory is called the 'Unthought', the ignorance we have and promote because we are incapable of or unwilling to look in certain directions (thanks largely to the established disciplinary structures) or think beyond the dominant paradigms ('unknown unknowns'). We have never faced so many problems simultaneously, we have never experienced such accelerating pace of change, or such globalised interconnections and complexity, and have never been so steeped in ignorance of things that have such extensive consequences beyond our own context. The established ways of knowing, doing and being are just not up to the task of moving us beyond postnormal times with our humanity, sanity and the planet intact.

Cole also takes a playful swing at the three C's that frame postnormal analysis: chaos, complexity and contradictions. He suggests that the triad constitute an Alliterative Logic, and traces the origins of this logic to the fourteenth century Black Death. The critique is based on the assumption/assertion that 'in the absence of empirical connection between ideas, humans theorise through alliterative word-triads' (Cole, 2011). Fortunately, there is no lack of evidence of 'empirical connection' for the advocates of postnormalcy. Ravetz and Functowicz, and a growing number of researchers working on postnormal science, have toiled for several decades to accumulate evidence of postnormal science that is truly formidable (Laugharne & Laugharne, 2002; Martinez-Alier, 2002; O'Connor, 2000; Ravetz, 2004, 2013; Ravetz & Functowicz, 1994, 1999). The evidence for complexity of our world is now overwhelming. And evidence for PNT, in most disciplines, is accumulating steadily. It would be more productive, I would argue, to look at the 'empirical connection' between the idea of PNT and what's actually happening around us than to play with questionable theories of Alliterative Logic. Alliteration, by the way, as Davies points out, is 'the point from which thought, as well as emotion and remembrance, begin'; the device is designed 'to stir people to stop and think and more importantly remember the vital connective lineaments of information and argument' (Davies, 2011b).

However, Cole, Gary and Kapoor have made useful contributions to the development of PNT theory. We should take heed of Cole's warning that any attempt to explore the future does not become a litany, a form of prayer. Gary's assertion that PNT theory needs more work, and a robust framework, is a valid observation. Kapoor rightly points out that large swathes of India and Asia, not to mention Africa and South America, have been untouched by modernity. In rural India, illiteracy is the norm, agriculture is in bad shape, towns and villages lack basic amenities, such as electricity, water and health care. Surely, such a

system, that is not networked or full of self-contradictions, cannot exhibit chaotic behaviour and go postnormal? The answer to this query lies in the answer to the question raised by Merryly Wyn Davies: 'Are we there yet?' Yes, and no. We are there and not there. Postnormality is not a homogenous phenomenon: it does not affect all segments of the planet equally. It can be witnessed in certain global and regional events but not in others. It can shape the developments of trends in certain countries but not in every country. So not every part of the world has gone postnormal; but every part of the globe *can* go postnormal. It can be recognised in certain systems – ecological, economic, social, political, and cultural – but not in all systems. It all depends on whether the system meets the basic conditions of networks, complexity, positive feedback, and contradictions. As we become more and more connected, as networks become more and more dominant, we will move closer and closer to the postnormal condition.

## 2. The postnormal condition

The postnormal condition is the particular mode of being and existence we find ourselves in. We are facing problems that are vastly different in scale and are interconnected and embedded in accelerating pace of change. Scale, networks and acceleration generate the 3C's – complexity, chaos, and contradictions – of PNT, which lead us towards uncertainty and ignorance. As an example of postnormal phenomenon, think of Greece, a relatively wealthy state that was reduced to abject poverty almost overnight. Consider how quickly the landscape of the Middle East has been transformed. The Tunisian dictator was brought down in 28 days; and replaced with a parliamentary democracy. In three years, Egypt spinned like a top from dictatorship to democracy and back to dictatorship (Sardar, 2013b). The Syrian insurgency started with clearly defined actors: the democratic opposition against the brutal regime of President Assad. It soon became a complex web of numerous actors – democrats, revolutionaries, Islamists, the Hezbolah of Lebanon, Iranian militias, Shias, Sunnis, Alawis, pro- and anti-regime groups, making contradictory demands and fighting each other. It became impossible to tell who was who and who and which side the West should support (Sardar & Yassin-Kassab, 2014). The conflict in Syria gave birth to a hitherto unknown group that called itself the Islamic State of Iraq and the Levant (Isis). Within months, it controlled an area, larger than UK, from Aleppo in Syria to Mosul in Iraq; became, as the *Guardian* put it, 'the most capable military power in the Middle East outside Israel'; amassed billions of dollars in cash; and transformed the very notion of terrorism, to use the words of US Secretary of State Chuck Hagel, 'beyond anything we have seen' (Chulow, 2014). The scale and speed, accomplished partly with savvy use of digital and global media, with which the extremist of 'Islamic State', so barbaric that even the old terrorist groups such as al-Qaeda shunned them, laid the foundations for substantial financial, military and political growth, is truly astonishing. 'The certainties of the old Middle East', notes Paul Danahar, have 'crumbled' in months (Danahar, 2014, p. 1). On the other side of the world, Russia was able to annex Crimea within a week; and the competing and contradictory interests in the Ukraine are no less complex. To resolve the issue of the Taliban in Afghanistan and Pakistan, one has to deal with hundreds of different types of Taliban, covering the whole tribal and political spectrum, each with its own specific demands.

Recent political events demonstrate that we are no longer dealing with isolated sequences of events, local in nature, separable in time, affecting a handful of individuals or a small community, and perturbing a small number of processes. The changes we witness today are swift and global, they reach out to touch every aspect of individual human life and social, political, economic institutions. The 'world order' is changing, notes Kissinger, with 'few if any limits', in such a complex way that there is no 'common interpretation – or even understanding' (Kissinger, 2014, p. 344). Yet, under postnormal conditions, events and situations develop rapidly to become chaotic and envelope the world. The rich, for example, get richer at super-speed; there are more billionaires now than before the global financial crash of 2008/9: 1126 in 2012, compared to 739 in 2009. In April 2013, the Bitcoin was valued at \$213. Eight days later it was \$63. A few months later it was \$1200. Within a year of its launch, Wikileaks had amassed 1.2 million confidential documents (Leigh & Harding, 2013). Twitter emerged from nowhere to be floated on the market within seven years at a value of \$34.7 billion (in truth, no one knows how much it is really worth). A volcanic eruption in Iceland in April 2010 created chaos in Europe and brought airline traffic to a halt for over a week. Malala Yousafzai, the school girl shot by the Taliban, rose from an obscure blogger to become a global icon within six months; within a year she was lecturing the United Nations and had published her autobiography (Yousafzai, 2013); within two years she had won the Noble Prize for Peace! On the other end of the political spectrum, Pastor Terry Jones, an unknown priest of an insignificant nondenominational Christian outreach centre in Gainesville, Florida, became a chaotic event when he threatened to burn the Qur'an in September 2010. His threat was broadcast on global television channels as though they were on a never-ending loop. The whole Muslim world reacted instantly and unthinkingly: demonstrations were held, embassies were burned, innocent people died, shops and public transport were torched – all of which generated even more television coverage, and sent social media into a frenzy. The then US Secretary of State, Hilary Clinton, was moved to say: it is 'regrettable' that a tiny congregation had gotten so much attention for a 'distrustful and disgraceful' act (CBS News, 2010). However, not all chaotic events generate 'the world's attention'. Consider the 'flash crashes' that can knock trillions off the stock market in minutes. One particular flash crash occurred on 6 May 2010, when at 2.30 pm local time something unexpected appears:

A flutter in the price of E-mini futures contracts, an investment vehicle traded on the Chicago Mercantile Exchange and regarded as a bellwether of wider sentiments. Almost no one notices, until the flutter becomes a shiver, then a spasm, amid whipsawing prices as the E-mini's vertigo spreads to other stocks exchanges, and indices begin to plummet. Within seconds, the Dow has lost 100 points. Finance workers turn back to their screens. But seconds later, another 100 has been shed and managers fly from their offices, yelling 'Pull everything', as traders hit buttons and hammer

keyboards, cancelling orders in an attempt to limit damage. In horror, they gather in communal spaces and watch price lines dive with eerie, implacable momentum, like lines scratched by an angry child.

300 points down. . .

400 points.

500 points. . .

At 600 down, the Dow has fallen further than it did on news of Lehman Brothers' collapse in 2008. But that crash took a day: this spasm minutes. . . Even 9/11 failed to rock the market like this – which implies that something catastrophic has happened. . . (no one can shut down the system because) the circuit breakers designed to halt trading after unnatural swings work only until 2.30 pm and it is now 2.47 pm, with the Dow racing towards an unprecedented 1000 point loss and almost 11tn wiped from balance sheets.

Then something even stranger happens as, with Armageddon approaching, the market turns tail and begins to rise, just as impossibly as it fell. (Smith, 2014).

Such chaotic 'flash crashes' are a natural product of a complex networked system that accelerate at astonishing speed. The market and the economic system are now run not by conventional traders but complex mathematical formulae, software algorithms and networks of computers – all of which provide a coating of scientific respectability to its intellectual foundations. For example, one widely used derivative model, known as the Black–Scholes model (Black & Scholes, 1973), supposedly gives a theoretical estimate of European-style options. It provided scientific legitimacy to the activities of the Chicago Board Options Exchange and led to a spectacular boom in option markets around the world. But stock exchanges are no longer what they used to be. The conventional stock market, as Michael Lewis shows in *Flash Boys* (2014) has disappeared. The New York Stock Exchange, for example, is no longer a physical place – it is over a dozen 'stock exchanges' dotted around New York, each a server farm of computers running algorithms. In this virtual space of networked servers of monumental complexity, stocks are bought and sold at the speed of light – even an advantage of a millisecond can produce massive profits. Predator algorithms hunt slower players 'in the same way a shoal of piranhas might an ox'. Not surprisingly, like most computers and networks it has a tendency to go chaotic and crash.

### 3. Climate chaos

The chaotic behaviour of the market and the political upheaval across the globe are only two illustrations of the postnormal phenomenon that we can observe currently. Another obvious candidate is climate change. Extreme weather events are now as common as common cold. The Panjab region of South Asia, covering both Pakistan and India, is flooded on a regular basis killing hundreds every year. During 2013, the world had a record 41 weather disasters, topping the previous high of just three years previously. California has been going through a severe drought for a number of years; 2013 was the driest year in California since 1580. In 2014, Chicago experienced a historic 'polar vortex': the entire city was frozen solid, including the Great Lakes. Britain faces exactly the opposite problem: Biblical flooding. The great deluge across south-western England during 2013–2014, accompanied by widespread flooding, broke a 250 year record. The river Thames has been flowing at its highest level since 1883. Typhoon Yolanda, that travelled across the Philippines in November 2013, moved at the unimagined speed of a Japanese bullet train (topping 320 km/h) destroying everything in its path (Stevenson, 2013). The world's oceans are becoming warmer, while polar ice sheets are melting and glaciers around the world are shrinking. The combination of these changes is raising sea levels. The entire Florida coast is being eroded by sea surges, with the west coast of Miami facing an imminent danger of going under the sea (Mckie, 2014). Maldives, described as 'ground zero' of climate change, is in danger of being submerged under the sea – entirely. On the other end of the spectrum, huge swathes of the world are drying up. Australia has faced several years of severe drought; the 2006 drought was said to be worse in thousand years and almost 80% of Queensland is affected. California is on 'the verge of such an epic drought, with its backup systems of groundwater reserves so run down that the losses could be picked up by satellites orbiting 400 km above the Earth's surface' (Goldenberg, 2014).

Rising temperatures has produced an imbalance in nature caused by movement of species as they try to find cold water or adapt to rising temperature. The scale and speed at which invasive species are spreading around the globe is unprecedented. In the US alone, there are over 50,000 alien species causing havoc with the flora and fauna: 'in the Caribbean, lionfish scour coral reefs of sea life; in Texas, feral hogs rampage through farmers' fields; in the Northwest, emerald ash borers turn trees into kindling; in the Great Lakes, zebra mussels encrust pipes and valves, rendering power plants worthless' (Walsh, 2014). In the shores of British Isles, the warmer seas have forced Britain's favourite fish, cod, to look north for cold waters; other popular varieties, such as plaice and sole, are also declining. In contrast, the warming of seas has been good for the jellyfish: their population is increasing rapidly. If you travel from Malaysia to Indonesia by ship, all you will see is endless swarms of jellyfish. In 1999, jelly-fish clogged and caused the closure of the Sual coal-fired power plant in Luzon, Philippines, causing a mass panic. In 2006, jellyfish bloom clogged the coolant system of *USS Ronald Reagan*, which at the time was world's most advanced aircraft carrier, disabling the \$5billion ship. In September 2013, a massive bloom of Moon jellyfish clogged the Oskarshamn nuclear power plant in Sweden and forced a shut down (Sweeney, 2013). As the warm water sends 'normal' shoals of fish to search for cold water, other wild life is affected. The puffins in the Gulf of Maine, for example, are dying out because their chicks couldn't swallow the fish that is now available. Indeed, the rising temperatures have wiped out the



zooplankton that supports the entire food web of Maine (Jacobson, 2014). Elsewhere, ‘starfish are dissolving into goo, and no one knows why’ (Lunau, 2014). If the trends continue, one-fourth of Earth’s species could be headed for extinction by 2050.

On 9 May 2014, the atmospheric concentration of carbon dioxide, the gas that contributes most to global warming, reached the critical level of 400 parts per million (ppm) – a level not seen in history. Climate change is thus no-longer a theoretical future threat but a reality of postnormal times; and, in a globalised, interconnected world, there is no hiding place from climate change.

Climate science also provides us with a good illustration of postnormal science. As Hans von Storch et al. note in their introduction to the special issue of *Nature and Culture* on ‘Postnormal Climate Science’, climate change ‘has many characteristics that make it hard to tackle with normal scientific procedures’. In general,

decisions need to be made well before conclusive supporting evidence can be available and decision stakes are high: the potential impacts of wrong decisions can be huge. In such situations actors tend to strongly disagree on the values that should guide the decision making, for example solidarity or economic growth. The available knowledge bases are typically characterized by imperfect understanding (and imperfect reduction into models) of the complex systems involved. Models, scenarios, and assumptions dominate assessment of these problems, and many (hidden) value loadings reside in problem frames, indicators chosen, and assumptions made. (Krauss, Schäfer, & von Storch, 2012)

In such circumstances, simple assumptions of cause and evidence, controlled experiments that are reproducible, are not of much use. We are faced with a plethora of uncertainties that cannot be resolved. ‘We cannot perform a statistically satisfying series of reproducible experiments to test the effect of higher atmospheric greenhouse gas concentrations, because there is only one Earth available, and even the one available is poorly monitored’ (Krauss et al., 2012). Moreover,

scientific assessments of climate change are unavoidably based on a mixture of knowledge, assumptions, models, scenarios, extrapolations, and known and unknown unknowns. Because of the limited knowledge base, scientific assessments will unavoidably use expert judgments and subjective probability judgments. It comprises bits and pieces of knowledge that differ in status, covering the entire spectrum from well-established knowledge to judgments, educated guesses, tentative assumptions, and even crude speculations. Research on climate change comprises a large variety of scientific disciplines leading to the well-known problem that when quantitative information is produced in one disciplinary context and used in another, important caveats tend to be ignored, uncertainties compressed, and numbers used at face value (Krauss et al., 2012).

The main problem here is the application of ‘normal science’ and its methodologies to postnormal conditions.

But it is not just in its method and policy that science has become postnormal. Conventionally, science has been funded by governments and corporations, what President Dwight Eisenhower described in his farewell address, in January 1961, as the ‘military-industrial-congressional complex’. While some science is still funded by governments and multinational companies, an increasing proportion is now paid for by individual hedge fund managers, software billionaires, business moguls, oligarchs, and tycoons – what the *New Internationalist* (2013a) describes as ‘the feral rich’. People like Sergey Brin of Google, Paul Allen of Microsoft, Richard Branson of Virgin, and Jeff Bezos of Amazon, and numerous others, have poured staggering sums into scientific research that outweigh anything that the government can come up with. Of course, they don’t promote all science. Only what they prefer – perhaps because a member of the family has died of a particular cancer, or it opens up a new market, or its grand scale massages their egos. These people are not interested in basic research but grand schemes such as space exploration, sea mining, or as in the case of the Russian oligarch Dmitry Itskov, a former media mogul, lifelike avatars. As Steven Edwards of American Association for the Advancement of Science notes, ‘the practice of science is becoming shaped less by national priorities or by peer-review groups and more by the particular preferences of individuals with huge amount of money’ (Broad, 2014).

All this is not the future. This is the postnormal present: the condition of the world, *Espiritu del tiempo*, the spirit of the age.

#### 4. The postnormal extended present

However, postnormality is set to increase in the near future. In postnormal theory we call it the ‘extended present’ – that is the immediate future of the next ten to fifteen years that will be shaped by the entrenched trends and developments we can identify today. This is not to suggest that these trends cannot be derailed or that they present us with an *a priori* given future. Trend, as it has been said so many times before, is not destiny. But to argue that if these trends continue, we are bound to find ourselves in an increasingly postnormal world. More specifically, trends associated with capitalism, health and medical systems, big data and the social landscape are rapidly taking us towards a postnormal extended present. It is worth noting that the 3Cs – complexity, chaos and contradictions – do not operate at equal levels on all situations. In some cases, complexity may be the biggest component; in others, it may be chaos or contradiction. But, in general, as the Cs accelerate and grow, they combine to produce a postnormal situation.

Consider capitalism. The abnormalities and contradictions of the capitalist system are not simply a product of ‘the Great Recession of 2008–2009’. They are deeply intrinsic to the system, which has become too complex, too interconnected, too contradictory, too steeped in deep uncertainty and ignorance to be anything else but chaotic. Indeed, any system based on the conception that economy is the sum of atomised action of millions of rational, profit-seeking individuals, where markets

are stable, facts are certain, values clear, and there is equality all-round, is bound to implode in a world where 'facts are uncertain, values in dispute, stakes high, and decisions urgent' (Ravetz & Funtowicz, 1999).

According to Bernard Schwartz, an investment expert and publisher of the journal *Democracy*, 'a sea change has occurred' in the financial system. Instead of building badly needed roads and bridges or running manufacturing plants that created goods and provided jobs, business people became fixated on complicated debt swaps and other abstract "products" that make money only for the broker. Some of these were so complicated and arcane, we now know, that they were beyond the comprehension of executives running the investment houses'. The most common comments Schwartz hears from 'more and more people' are: 'our primary system is broken' and 'the financial system is not working' (Schwartz, 2014). But it is not just the financial sector but the whole damn economic system that is now beyond repair.

Capitalism has become a 'horror show', according to David Simon, the creator of the celebrated television show 'The Wire' (Simon, 2013). Bankers are not out of control, they are 'beyond control', says Joris Luyendijk, the Dutch economic writer, talk show host and blogger for the *Guardian* (Luyendijk, 2013). After conducting interviews with over 200 bankers, Luyendijk concludes: 'employees at the big banks themselves do not believe their top people know what's going on; the big banks have simply become too complex and too big to manage'. Running a bank nowadays is like 'playing Russian roulette with someone else's head'. The whole system is 'highly dysfunctional, deeply entrenched, and enormously abusive, both to its workers and the society it operates in'. Similar arguments and sentiments are echoed in a string of recent books such as Naomi Klein, *This Changes Everything*; Paul Krugman's *End This Depression Now*; and David Harvey's *Seventeen Contradictions and the End of Capitalism* (Profile Books, 2014). All of which suggests that capitalism and the entire economic system based on it has now rapidly becoming postnormal. It is only a matter of time, the PNT theory tells us, before it takes us to the edge of chaos – and either implodes and collapses, or creates a new order, a radical transformation to a more viable way of doing business and commerce.

At the heart of the economic system are assumptions that present us with its basic contradictions. For example, that growth is essential and will continue into the far future. The ideal figure that any country should aim to grow at is said to be 4.5%. However, as the investment banker Jeremy Grantham notes, 'the fact is no compound growth is sustainable' (Grantham, 2012). To show just how unsustainable this is in reality, Grantham suggests that we imagine an ancient Egyptian culture that seeks a growth rate of 4.5%. How much wealth would they have accumulated after 3000 years? The answer: 2.5 billion billion solar systems worth! At 1% compound growth their wealth could not be accommodated on the planet. Even a lowly 0.1% rate of growth would break the system. Thus the seeds of postnormality are inherent in the very idea of growth. The more economic growth we have the more postnormal we become.

There is also the issue of inherent inequality in the capitalist system. As Thomas Piketty shows in his brilliant study, *Capital in the Twenty-First Century* (2014), capitalism has actually increased inequality over the past two centuries. Piketty's main argument, supported by massive data, is that when the rate of return on capital exceeds the rate of growth of output and income, capitalism automatically generates arbitrary and unsustainable inequalities. If we continue with business as usual, we will return to, and in many countries may already have attained, the levels of inequality characterised in the mediaeval period. The latest OECD forecasts for the global economy up to the year 2060 suggest exactly such a scenario (Braconier, Nicoletti, & Westmore, 2014). The OECD predicts growth slowing to two thirds of its current rate with massive increases in inequality despite the world becoming four times richer, more productive, more globalised, and more highly educated.

The absurd disparity between the salaries of managers and workers has attracted much public attention. But there is another kind of inequality over the horizon. The people who write and run the market algorithms are not financiers, brokers, investment bankers, or even programmers. They are quantum physicists, climate scientists, and theoretical mathematicians – known as Quants. Their technical abilities not only enable them to by-pass public regulation and oversight but also bring enormous power, creating a new kind of inequality. And the algorithms themselves are designed to enrich certain people over certain others and privilege certain aspect of the globalise world at the expense of more important life-enhancing aspects. As Costas Lapavistas shows in *Profiting Without Producing: How Finance Exploits US All* (2013), toxic finance has entered every aspect of our globalised world from carbon markets to biodiversity derivatives, catastrophe bonds to weather derivatives.

Moreover, algorithms produced by Quants are now set to take over most of our lives. They are already been used in online dating services. Soon, algorithms will be used in recruitment, student assessment, delivering benefits, health service, and much else besides. The potential for 'flash crashes' and chaotic behaviour will thus increase manifold. As will protests against inequality, corruptions and malpractice of governments. The mass demonstrations we have witnessed in the world over the past few years, including those that engendered the Arab Spring, are essentially about inequality. But they are not conventional demos: they are complex networks, protestors react instantly on social media, and move rapidly towards the edge of chaos. The workers at the Yue Yuen factories in Dongguan, southern China, for example, use an instant messaging app called QQ and Weixin to 'create numerous overlapping groups', and use Weibo, a Twitter-like service, to disseminate news (Mason, 2014). Similarly, strikes by truckers in England, USA, and elsewhere are fuelled by social media. The probability of the protests becoming chaotic is thus very high. Not surprisingly, in some cases, protests have brought governments down. The anti-government protests in Thailand, between November 2013 and May 2014, were largely about inequality and corruption; they succeeded in bringing down the democratically elected government of Prime Minister Suthep Thaugsuban, which was replaced by a military junta. During September 2012, half a million people rallied against the government of President Cristina Fernández de Kirchner of Argentina. The demonstration were triggered by a rise in the price of public

transport but soon escalated throughout the country and nearly brought the government down. The Gezi Park protests in Istanbul on 28 May 2013 became chaotic and destabilised the government of the ruling Justice and Development Party (Steffey, 2013). The two mass-demonstrations in Pakistan during August 2014, led by Imran Khan, leader of the Justice Party, and Tahir-ul-Qadri, a cleric who heads a religious movement, were motivated by inequality, corruption and elite dominance of politics. The protests brought Pakistan to a stand still for months. All of these protests were fuelled by digital media and whipped up by 24-h global media coverage – and transformed into chaotic events.

## 5. Big data

The potential for chaos is further enhanced by Big Data, which is being collected, stored, copied and analysed from every conceivable source. In 2013, there were an estimated 4.4 trillion gigabytes of globally available data – equivalent of 120 DVD movies for every person on the planet. It is set to rise by 40% annually over the near future. But Big Data is not just big in scale, it is also complex and high velocity stuff: it has to be collected and analysed at the same rate it is collected to be useful. And it is high variety: it exists in many forms and collected from a plethora of sources. However, it may be big and fast, but it can also be inaccurate and highly unreliable as well as have qualities that may change over time. So while big data has now become a standard source of all kinds of analysis, used to identify all variety of correlations, and is set, as the subtitle of recent book suggest, to ‘Transform How We Live, Work and Think’ (Mayer-Schonberger & Cukier, 2013). But it is also set to make Big Mistakes in the future. Correlations may be useful for predicting or measuring previously unknown or unseen behaviour, provided they are reliable. But correlations can be misleading. A frequently cited example states that knowing that a huge number of people are using google to search for flu epidemics at a particular time may be useful for targeting sales of flu remedies but it tells us nothing about an imminent flu epidemic (Butler, 2013). As Butler and others have pointed out, this data is theory free; in other words there is no hypothesis that provides a useful link between search terms such as ‘flu symptoms’, ‘flu remedies’ and ‘pharmacies in my area’ and ‘flu epidemic’. If you simply take a cluster of top terms and run the algorithm you are not going to get a meaningful answer. Correlation does not tell us anything about the causes of flu, the only real basis for understanding the spread of an epidemic.

This type of ‘predictive analytic’ has other inherent dangers. Someone researching terrorism for example may end up being suspected of terrorism, as happened to Rizwaan Sabir a PhD student in Britain, who was working on UK counter-terrorism at the University of Nottingham (Sabir, 2011). And someone collecting knives as a hobby could end up being targeted for stop-and-search by the police. After the Boston marathon bombing, a New York writer googling ‘pressure cookers’ and ‘backpack’ found armed police hammering on her door (Gabbat, 2013). The Metropolitan police in London are already using big data analysis in a Minority Report-style predictive tactics to tackle burglars and muggers. In the film a ‘precrime’ department stops offenders before they commit their acts. The Metropolitan police deploy officers to areas of ‘future crime maps’ that are generated daily. The maps are produced using computer algorithms that combine local crime patterns, mathematics, and theories of foraging wild animals to pinpoint where crimes will happen next. Each map has a ‘predictive area’ of a typical radius of 300 m, usually covering a number of defined streets (Leppard, 2013). Given the fact that scientists can now distinguish between a scan of a ‘normal’ brain and that of a criminal, the trends are well established to take us towards a brave new postnormal world – a point well made in a new adaptation of George Orwell’s *Nineteen Eighty Four* by Robert Icke and Duncan Macmillan. Winston, the protagonist, finds himself in two overlapping time zones: the landscape of the novel with its two-minutes of hate, Ministry of Love and the terrifying room 101 and an unspecified near future. The parallels are striking. The extended present through which a shattered Winston staggers appears ‘normal’ but where privacy and individual liberty are conspicuous by their absence, there is always a camera watching you, and you are always at the edge of chaos.

Privacy evaporates with the arrival of big data. Often the data is collected automatically and anonymously, although sometime we are forced to tick a box to give our ‘permission’. As John Naughton, Emeritus Professor of the Public Understanding of Technology at Open University, UK, and a columnist of the *Observer*, notes big data comes with a big price tag: ‘the systematic elimination of personal privacy, which in turn implies the emergence of a society in which surveillance is comprehensive and pervasive. We may be headed in that direction anyway, courtesy of the intelligence agencies and the internet companies. . . Big data is a technology for the big battalions, not the rest of us. It will further increase the power of large corporations and governments, and further disempower the poor and the socially excluded’ (Naughton, 2014).

Just how extensive is this surveillance is brought into sharp focus by the classified documents made public by Edward Snowden, a right wing contractor to America’s National Security Agency (NSA). During the Cold War, it would be an achievement for a spy to steal more than a document or two after years, if not decades, of espionage. In postnormal times, Snowden managed to steal a staggering 1.7 million files, neatly tucked up in a flash drive. As Luke Harding’s *The Snowden Files* (2014) reveals, Snowden was particularly alarmed at the sheer scale and complexity of NSA, its formidable technological reach, its ability to cross borders freely, and capacity to co-opt technology giants such as Google, Facebook, Twitter, as well as telecommunication companies like Vodafone. It had become a monstrous machine that automatically and comprehensively sucked all human communications, with mindboggling capacity to snoop on anyone, anywhere in the world, at any time, where no one seems to have any responsibility or knew what was going on. Indeed, it was so gigantic and so unwieldy that it did not even notice what Snowden was up to, even though he was already under suspicion at his former post at the CIA. Once the data was in the public domain, no amount of skulduggery could get it back or erase it!



As privacy dissolves, the boundary between public and private becomes increasingly diffused. It is interesting to note that while there is a great deal of concern about erosion of privacy, there is a simultaneous and contradictory desire to put our private lives in the public domain. We provide a running commentary on our lives on Facebook; we publish every thought we have, however absurd, on Twitter; and we put pictures of our babies, birthdays, cats, food and everything in between on Instagram. Yet, at the same time, we want 'inadequate, irrelevant or no longer relevant,' aspects of our lives deleted from the internet. We have, as the European Court has announced, the 'right to be forgotten' (Travis and Arthur, 2014). But how can we be 'forgotten' when our very sense of who we are and what is important to us is now embedded in our intense desire to share every aspect of our life. And these include images of our bodies, which were normally seen as our most sacred, private parts. The importance of something – an idea, an image, an argument, a policy – notes James Graham, author of the play 'Privacy', 'is no longer measured by its quality but on how far it is shared. The measure of your impact on Twitter is called "clout" – a value determined not on the quality of what you write but on how many people will see it. The value of life experience is reduced to how many likes you get on Facebook' (Graham, 2014). Every newspaper or magazine article, every blog or post, asks you to share it and tell your friends you have read it.

The more we rely on digital media and the internet the more we expose ourselves to fraud, scams, and criminal activities. It is hardly surprising that data breaches are becoming bigger and frequent. In 2013, over 800 million records were stolen from a whole range of industries from financial services to health care, education, pharmaceutical, consumer, energy, media, transport and retail. Amongst the most prominent victims in the USA were the retail store Target, e-Bay, Sony, LinkedIn, RockYou.com, and the software giant Adobe. A computer virus known as Shmoon wiped the hard drives of a network of tens of thousands of computers at Saudi Aramco, the Saudi Arabia oil and natural gas giant. The cost to the global economy of cyber-crime stands at \$455 billion a year – about as much as the GDP of Austria (Baker and Lewis, 2013).

So imagine, against this background, the chaotic potential of 'Internet of things': when your fridge, cookers, smoke alarms, door locks, home security system, webcams, televisions, cars, medical devices and much else besides is connected to the internet. 'First, we'd install cameras in our kitchens to receive better instructions', writes Evgeny Morozov, 'then food and consumer companies would tell us that they'd like us to keep the cameras to improve their products, and, finally, we'd discover that our cooking data now resides on a server in California, with insurance companies analysing just how much fat we consume and adjusting our insurance premiums accordingly. Cooking abetted by smart technology could be a Trojan horse opening the way for far more sinister projects' (Morozov, 2013, p. 13). We will surely be riding a wave to postnormal existence. Of course, all that cooking data could be hacked with little special knowledge. No matter how good the software, there are always inherent weaknesses. A recent discovery is the Heartbleed bug, a serious vulnerability in the popular OpenSSL cryptographic software library. It allows anyone on the internet to read the memory of the system, identify service providers, and the names and passwords of the users and the actual content; and allows attackers to eavesdrop on communications, steal data directly from the services and users and to impersonate services and users. Software makers usually issue 'patches' to fix their software. But there is always a time-lag between the discovery of a new vulnerability and the appearance of a 'patch' that fixes it. The in-between time, when the hackers first begin to exploit the vulnerability and cause chaos and the developers realise that there is a problem and produce a patch to fix it, is called zero-days. Up to now zero-days have been rare; the flaws remain undetected for an average of ten months. But as software become more and more complex, and more and more things are connected to the internet, zero-days will escalate with obvious postnormal consequences.

Just think how much of our critical infrastructure is on-line. The more networked computers are deployed on national grids, such as electricity (even a 'smart metre does the job), the more 'attack surface' the grid provides. The greater the 'attack surface' the higher the probability of the grid going down. Almost all industrialised countries are now involved in cyber warfare, with the US leading the way (Bamford, 2013). In 2012, there was a rise of 52 per cent in cyber-attacks on power and nuclear targets in US alone. Once again, we are faced with a system that according to PNT theory is ripe for chaotic behaviour and catastrophic consequences.

## 6. Health and medical systems

The health system is also going postnormal. Over the last decade, despite many medical advances, there has been an accelerating rise in modern diseases. Of course, diseases have been with us throughout history. They spread at the rate that was the rate of travel of a particular period. During the fourteenth century, expanding trade routes spread rat-borne Black Death across Europe and smallpox to the Americas by ship. In more recent times, the interconnected world has seen the spread of SARS, Swine flu, West Nile virus, H5NI bird flu and Ebola at jet-speed. Moreover, the rate at which pathogens are emerging is accelerating, even with the increase in awareness and surveillance. A modern outbreak, caused by a previously unknown virus, can envelope the globe with frightening speed.

But it is not just new pathogens that are of concern. The world is facing a whole series of epidemics brought about by modern lifestyle: obesity, diabetes, asthma, hay fever, eczema, food allergies, oesophageal reflux and cancer, coeliac disease, Crohn's disease, ulcerative colitis, and autism (Blaser, 2014b). In the US, one in 13 children has a food allergy, and the number with peanut allergy tripled from 1997 to 2007. Globally, over 1.4 billion people are overweight, around 300 million qualify as obese. An estimated 800,000 children develop Type 1 Diabetes annually around the world. In UK alone, 5.4 million people suffer from asthma. Childhood asthmas increased by 50% in the US from 2001 to 2009. Some 30 per cent of Australian children develop Eczema in their first year. Food allergies – from peanut to milk, bread, eggs, soy, fish and fruits – are

everywhere. The incidence of inflammatory bowel disease, including Crohn's and ulcerative colitis, is rising. These disorders suggest that children throughout the world are experiencing levels of immune dysfunction never seen before, observes Martin Blaser, author of *Missing Microbes: How Killing Bacteria Creates Modern Plagues* (2014a).

But that is only a small part of the story. A recent report by WHO suggests that 'a post-antibiotic era – in which common infections and minor injuries can kill – far from being an apocalyptic fantasy, is instead a very real possibility for the 21st century' (WHO, 2014, p. ix). Effective antibiotics have been one of the pillars of modernity allowing us to live longer, live healthier, and benefit from modern medicine. But antibiotic resistance, which 'is complex and multidimensional', is spreading rapidly and 'involves a range of resistance mechanisms affecting an ever-widening range of bacteria, most of which can cause a wide spectrum of diseases in humans and animals'. The resistant pathogens travel the globe with ease. According to WHO, pneumonia will again become a feared killer, diarrhoea deadly, and drug resistant tuberculosis, which requires more than a year of treatment, fatal. Gonorrhoea resistant to antibiotics is set to make a comeback, as are the treatment-resistant strains of HIV. The widespread resistance to fluoroquinolones – one of the most widely used antibacterial drugs for the treatment of urinary tract infections caused by *E. coli* – presents us with a truly frightening scenario. There are no new antibiotics to replace the old one; in fact, there have been no new antibiotics for the last 25 years.

Medicine is a complex ecosystem. The absence of antibiotics will have an impact across medicine in all branches. Surgery will become risky. Cancer treatment will be compromised: cancer patients undergoing chemotherapy need antibiotics to handle otherwise potentially fatal side effects as their immune systems reel from the impact of chemotherapy. Antibiotics don't just kill bad bacteria, they also kill the good bacteria. The over use of antibiotics means that we have less and less good bacteria in our bodies, which means our immune systems are less and less able to cope. Thus, antibiotics affect not just the person who takes them; they affect the entire planet. The abuse and overuse of antibiotics in humans and animals is set to nudge our entire health system towards postnormality.

The emergence of antibiotic resistant pathogens is only one reason amongst many for the rapid rise of new maladies. Some disorders, such as the rise of allergies, can be explained by the fact that we live in 'germ-free bubbles'; our immune systems have had little chance to develop responses to allergies. But such single-cause explanations do not take us very far. As Blaser states: 'a single cause is easier to grasp; it is simpler, more parsimonious. But what cause could be grand enough to encompass asthma, obesity, oesophageal reflux, juvenile diabetes, and allergies to specific foods, among all of the others? Eating too many calories could explain obesity, but not asthma. Air pollution could explain asthma but not food allergy'. Blaser suggests that a major cause is the loss of microbial diversity, which 'changes development itself, affecting our metabolism, immunity, and possibly even our cognition. Microbes in our guts have a role in the production of some of the building blocks of the brain, as well as the molecules that provide signals from one brain cell to another'. Blaser calls the process 'the disappearing microbiota'; and predicts that 'it will be worse in the future. Just as the internal combustion engine, splitting the atom, and pesticides all have had unanticipated effects, so, too, does the abuse of antibiotics and other medical or quasi-medical practice'. We are heading towards 'an "antibiotic winter"'. We know that the "good bacteria" protect us against the "bad" ones, the pathogens that we may encounter over the course of a lifetime. As our populations of good bacteria become depleted, our susceptibility to the bad ones grows' (Blaser, 2014b).

What it means to be human is also about to change radically. For centuries, the West has assumed there is only one way to be human: the modern way. This assumption has been the biggest hurdle in the appreciation of human diversity. Now advances in genetic engineering and synthetic biology are undermining the conventional view of what constitutes a human being. Consider, for example, the experimental treatment called mitochondrial replacement: it involves taking the genetic material from a man and a woman and cellular material from a third person to create an embryo. The faulty mitochondria from the mother is replaced with those of a healthy donor. The resulting foetus thus has not two but three parents. Or, as another example, think of pre-implantation genetic diagnosis (PGD), which was initially developed to help families with a history of serious genetic disorder to select embryos for IVF that are unaffected by the condition. But it can be equally used, and has been used, to select an embryo's sex. The practice has been widely used in India and China. In China, around 118 boys are born to every 100 girls; India has a national average of 111. But the practice is also gaining ground in places like Azerbaijan, Armenia, Georgia and Albania (New Internationalist, 2013b). Apart from sex selection, one can also tweak the baby. Indeed, in India, where bleached, fair babies are preferred by the rich middle class, PGD has been widely used to produce 'milky-white' babies. Moreover, just as easily, one can choose to have a child with disability!

Developments in biosciences and computer technologies have been so rapid that a scholarly cult of 'transhumanists' now argues that within the next few decades enhanced human beings will be walking the earth (Braidotto, 2013; More & Vita-More, 2013). Or as 'Dr. Will Caster' put it, during his presentation at 'Evolve the Future' conference in the 2014 film *Transcendence*, 'for 130,000 years our capacity for reasoning has remained unchanged. . .once online a sentient machine will quickly overcome the limits of biology. And in a short time its analytical power will be greater than the collective intelligence of every person born in the history of the world. Imagine such an entity with a full range of human emotion, even self-awareness. Some scientists refer to this as the singularity. I call it transcendence'. By the mid-century, the transhumanists argue, a 'singularity' will result through which a genetically engineered and enhanced post-human species will emerge – far stronger, wiser, and able to live much longer than mere mortals (Kurzweil Ray, 2006). We may dismiss this as dystopian fantasy; and *Transcendence* is certainly meant to be seen as such. It ends with a complete shutdown of the internet, which places the whole world in total darkness. But this should not blind us to the fact that human enhancement through technology is set to become a common practice. In the last two to three years, gene editing has become faster, cheaper and more precise. When technology is cheap and widely available it tends to get used.

Indeed, artificial life has already been created if we are to believe Craig Venter, the American geneticist who was amongst the first to sequence the human genome. In *Life at the Speed of Light: From the Double Helix to the Dawn of Digital Life* (2013), Venter describes how he created the world's first synthetic life. Synthetic bacterial genome is constructed from chemical in the laboratory and then 'booted up' by inserting it into living single-celled bacterium. The cell replicates itself into a colony of organisms containing only the synthetic DNA. 'It's like a whole new concept of life', Venter says. 'There is not a single molecule of the original from there – it's like converting you into a frog'. More sophisticated organisms can be made by using 'connectable pieces of DNA called BioBricks, which programme a host of bacterium to perform specific tasks. Each BioBrick is capped at both ends with DNA sequences that enable it to be connected to other bricks and integrated into a plasmid that can be inserted into a bacterial cell' (Venter, 2013, p. 205). There is even a Registry of Standard Biological Parts that one can use. Soon, life will finally be 'able to travel at the speed of life, the universe will shrink, and our own powers will expand' (Venter, 2013, p. 250). In an interview with the *Observer*, Venter warns not to dismiss this as a fantasy: 'we are actually doing the future'.

Indeed, what Venter is doing is not 'the future' but, what is called in PNT theory, 'the extended present': the consequences of his work can be seen in the present and will unfold within the next few years. As will the current research on human biology which enables us to generate body parts, such as livers, from stem cells that are taken from human skin and reprogrammed into an embryonic stage. Which raises the question: What is 'the body' when it consists of parts printed on a 3-D printer? As Warren Ellis, the novelist and Marvel comic writers, notes: 'everyone talks about disruptions to the norm – whether it is synthetics or 3-D printing or whatever. What they don't get is that it's a feral process; once disruption is out in the wild, it doesn't stop. In 10 years' time, there are going to be kids in basements 3-D printing additional organs and working out ways to stitch them into their bodies' (Ellis, 2014).

## 7. Social landscape and the next generation

Finally, the social landscape itself is about to be radically transformed. The 'normal' notions of what is a marriage, what is a family, and the idea of childhood innocence have already, or are about to, go postnormal. The old idea of marriage between a man and woman now has a new addition: homosexual marriage – at least in the West. One could just as easily have two fathers or two mothers, as a mother and a father, or indeed three parents. Indeed, monogamy itself seems to be slowly evaporating. According to Deborah Anapol of *Psychology Today*, 'our cultural obsession with monogamy is going the same way as prohibition, slavery, the gold standard, and mandatory military service. In other words, while serial monogamy is more popular than ever, lifelong monogamy is pretty much obsolete, and for better or worse, polyamory is catching on' (Anapol, 2013).

Children are growing up with a drastically different set of values than their parents. Prominent amongst things that teenagers share in digital media is pornography. It is not just that 'sexting' has now become a routine activity, but young teenagers have, as *Sunday Times* put it, 'a smorgasbord of unimaginable depravity at their fingertips'. When you consider that over 36% of the internet is devoted to pornography, one in four search queries is about porn, and a third of all downloads are porn, you realise the true extent to which pornography has penetrated everyday life. It has been suggested that the average age of first exposure to pornographic images in the West is between eight and six. Whatever the ethical arguments for or against pornography, the fact is that it has a devastating effect on the nascent young cannot be dismissed: 'they think these gross scenes are normal and set out to copy them as they take their first steps into sexual activity' (Mills, 2013)

Six is also the average age when a child masters digital technology. A recent report by Ofcom, the Independent regulator and competition authority for the UK communications industries, suggests that children born in the new millennium are exceptionally technology savvy. As they have grown up in the digital age, their communication habits are quite different from older generation. According to an Ofcom, children between 12 and 15 spend more time communicating than sleeping (Ofcom, 2014). Six to seven year old, who have grown up with Youtube, Spotify, Facebook and Instagram, have knowledge of superfast broadband, 4G mobile phones, how to operate tablets and apps that is exceptionally high. Their digital quotient (DQ) is even higher than 16–14 year group.

This age-cohort will grow up with wearable cameras that record their every move and utterance, where lives are completely lived on-line, where every face and every word can be instantly retrieved (Singer, 2014). Like climate change, the digital effects on this generation will be global, unparalleled and complex. As Susan Greenfield argues, social media is actually altering the brain, decreasing empathy and reducing the ability to communicate of excessive users (Greenfield, 2014). When this age-cohort takes positions of power, within two decades, its focus will not be on whether things are true or false, good or bad, but on how and how fast they work. This generation, brought up on the global language of emoji, will have its own specific desires, expectation, and way of seeing and shaping the world: a world of instant and perpetual change, instant gratification and utility, where every aspect of life is networked, and complexity, contradictions and chaos are upfront. In other words, a truly postnormal ecosphere.

The future of science may also look very different give the crisis in physics. The unresolved problems of supersymmetry (Lykken and Spiropulu (2014), the anomaly in the proton radius (Bernauer & Pohl, 2014), the issues of dark matter and dark energy, the famed black hole information problem (if the incoming particles start in a pure quantum state, Hawking's calculation predicts that the black hole evaporates into a mixed, thermal-like final state, with a massive loss of quantum information – which violate quantum mechanics), may all lead to an epochal paradigm shift in physics. We may be on the verge of a radically new perspective and understanding of the cosmos – a truly postnormal proposition.

## 8. 'Be Postnormal'

So how do we cope with postnormal times, given that the notions of progress, growth, control, efficiency and even management are increasingly becoming irrelevant? How do we move forward without falling prey to chaos? How do we survive increasing uncertainty and the different varieties of ignorance that we face? How do we transcend the obvious failings of capitalism and promote equity and social justice? What should follow the dissolution of 'world order' so perceptively noted by Kissinger? How can we overcome the dangers of 'life designed to order' (Caplan, 2010)? How do we meet the challenges to our health systems in a 'post anti-biotic' era?

The answers to these, and a plethora of other questions raised by postnormal times, begin with awareness and end with creativity and imagination.

We need to be aware that we cannot manage and control postnormal times, but we can navigate through them. We need to be aware of the fact that the multitude of problems we face simultaneously cannot be solved in isolation: when you look at a problem you also have to look at all the other problems it is connected with and to. As Jordi Serra notes, the linear cause and affect relationships do not hold anymore: 'action on just one element is not only futile but often also quite dangerous. Action on A triggers myriads of reactions in B, C, D all the way to Z; and many of these reactions can acquire chaotic proportions at lightning speed' (Serra, 2014). Moreover, given that these problems are complex and are embedded in a complex environment, there solutions cannot be simple. A major principle of survival in a complex environment is that the mechanism that deals with it must itself be complex – what is known as Ashby's Law of Requisite Variety (Ashby, 1956). The larger the variety of actions available to a system, the larger the variety of perturbations it is able to compensate: or to put it in other words, only variety can cope with variety. Thus, plurality, diversity and multiple perspectives are essential for understanding and steering through postnormal conditions. Furthermore, the web of our interconnected problems cannot be solved by old fashioned binary logic and reasoning. It needs a higher form of logic and what Jennifer Gidley calls 'postformal reasoning' (Gidley, 2010): complex thinking, the ability to handle multiple perspectives with competing notions of truth, the capability to transcend contradictions, and the intuition to deal with ambiguous knowledge and epistemological uncertainties. To be aware of this actuality is to 'be postnormal'.

What does this mean in terms of futures studies – how it is done and conceived? I would argue that futures must now incorporate postnormal landscapes in its purview, methods and analysis. Given that the extended present and the near future will be dominated by postnormal events, it is imperative that futures research and scholarship focuses on detecting and scrutinising postnormal trends and developments; and methods and tools are developed to analyse the complex and interconnected consequences of postnormal phenomenon. It is no longer enough to simply explore a variety of possible futures; we also need to give serious attention to how we are going to navigate the postnormal condition – the ever present potential economic collapse, the drastic consequences of climate change over the horizon, the possible failure of the human immune system – to reach sane and viable futures. On the whole, futurists have avoided big questions (normally seen as the subject of philosophy) and concentrated on analysing trends, horizon scanning, building global models and creating scenarios, visions, images of alternative futures (Sardar, 2013a,b,c). But in postnormal times, when what constitutes economic activity is being questioned, when the body is itself being reshaped, when social relations are being reconfigured, and the very idea of what it means to be human is being transformed, big questions cannot be ignored in futures work. Considering that postnormal times are hinting at changes of fundamental nature, it is important that we explore what these changes mean for all the diverse human and non-human cultures of our planet, and what radically different alternatives could emerge. Almost all the changes that postnormal times are ushering have deep ethical connotations. This means that exploration of futures must explicitly engage with ethical issues. Ethics is not just about how we, human beings, are located in the world, it is also about the human that is thus located. It is not just about being-in the world, but also about being-with the world. It is about how we are related to the rest of the world – the individual within a web of community, the resources we share and distribute amongst ourselves, our relationship with the flora and fauna, nature and environment, planet and the cosmos. Therefore, futures studies cannot simply be about what could happen in the future, or what can be done to shape a future, what is possible and what is not. It has to be largely about what ought to be done *for* the preservation of sane, ethical futures. Or to put it another way: futures studies ought to be exploring other ways of being human in all our futures.

Perhaps the most fundamental shift that postnormal times will usher will be in the power to define. During the eras of colonialism, modernity and post-colonialism, the West had defined what it is to be human and 'modern', what is freedom, rationality, science and civilization, what is 'free market', 'democracy' and 'international law', what are 'human rights' and 'humanitarian causes', and is economics, political science, architecture, art, history and tradition, what is sacred and what is not. The real power of the West rested on its power to define the key concepts of humanity and human society. But postnormal times tell us, if it tells us anything at all, that these definitions have passed their 'sell by' date. This is where creativity and imagination enter the equation.

Alfonso Montuori has pointed out that creativity and imagination are being transformed, as a by-product of PNT, from the individualistic/atomist view of modernity to a more contextual, collaborative and complex approach (Montuori, 2011). Sean Cubitt and his colleagues have argued that a new arrangement of networks now possess as much power as nations and markets, and the challenge for PNT is to 'imagine the future by imagining the political consequences of recognising non-human agencies as political actors' (Cubitt et al., 2010). Alfonso Montuori and Gabrielle Donnelly have suggested that we need to focus our attention on 'open source' creativity to move from 'zero-sum relations in the old worldview' to 'win-win relations' that transcend contradictions, difference and conflict (Montuori & Donnelly, 2014). We need to take these



suggestions seriously. But there is another reason why imagination and creativity will become paramount: we will need new and more inclusive definitions of numerous things that we have taken for granted from what is the body to what constitutes social relationships, what does good health mean, what is freedom, to what it means to be human. As power shifts from West to East, and as we navigate the ‘horror show’ of capitalism, new definitions of our fundamental notions will emerge from non-western cultures as they exercise their muscles. Even though China and India tend to follow the western capitalist model, they may still produce radically different versions – although not necessarily inclusive, open and pluralistic ones. We need to extend the horizons of our creativity and imagination to ensure that requisite variety, complexity and postformal reasoning are central to the new definitions. In other words, we need creativity and imagination to shape a Postnormal Ethics that can guide us through the turbulence of postnormal times.

A good illustration is provided by Frances Whitehead, artist and professor of sculpture at School of the Art Institute of Chicago, who sees urban landscapes as ‘complex, ambiguous, and contradictory physical spaces’, ‘symbols of a passing era of material prosperity’, which ‘continue to affect and be affected by the local community, ecosystem and infrastructure’. Whitehead consciously describes her work on urban renewal and cultural heritage as postnormal: the prefix ‘post’, she writes, ‘serves as a reminder of the embedded complexity’, describes ‘the current state of ecological, economic and social-cultural affairs, and implies that we are indeed living in the future of a past era. This trope also implies that we invoke our past as part of our current paradigm – *Post-carbon*, *Post-industrial* and *Post-colonial* are inherited cultural landscapes, literally *Post-Normal Cultural Heritage*’ (Whitehead, 2012). Her work emphasises the interconnection of things, uses locavore logic and brings ethics and aesthetics into high relief. In one of her projects in Chicago, called The 606 (after the first three digits of the zip code) and involves transforming a huge dilapidated area into multipurpose recreational trail and park system, Whitehead has introduced the concept of ‘Slow Cleanup’, which ‘moves Post-Carbon environmental remediation into the territory of Post Normal Science as it engages the Chicago community and leverages underutilised capitals (assets) of space, time, and human capacity’. In another project in the historic centre of Lima, a crumbling UNESCO heritage site that is the abode of the urban poor, she and her colleagues are trying to create ‘meaningful urban agriculture programme, integrating architectural conservation and the needs of current inhabitants’. Connections are made through potato research to colonialism, Peruvian culture, modern urban interventions, to the rural countryside of west Ireland. Here, she notes, ‘we return full circle to Post-Normal Cultural Heritage, manifest in the underlying ethical and even pragmatic dilemma of sustaining a desert city that is arguably in the wrong place – a perpetual colonial legacy that must be examined as an unsustainable settlement pattern’ (Whitehead, 2013).

Whitehead is literally imaging herself out of the postnormal times. She will surely be followed by others who will use their creativity and imagination to produce new definitions of everything from art to architecture, politics to policy, science to spirituality and what it means to be human in postnormal times. Time for me to listen to ‘Artic Blood and Ice’ by the Canadian experimental band ‘Post Normal’. Their music combines postnormal science, themes and images from different ethos, including indigenous cultures, with glam rock and pop to point out that something is terribly wrong with our times; we ought to be able to do better. ‘I am hunting for a song to sing’.

## References

- Allen, P., & Varga, L. (2014). Modelling sustainable energy futures for the UK. *Futures*, 57, 28–40.
- Anapol, D. (2013). *The Truth about Polyamory*. *Psychology Today*, April 18.
- Ashby, W. R. (1956). *An introduction to cybernetics*. London: Chapman & Hall.
- Baker, S., & Lewis, J. (2013). *Estimating the cost of cybercrime and cyber espionage*. London: Centre for Strategic and International Studies.
- Bamford, J. (2013). *NSA snooping was only the beginning. Meet the spy chief leading us into cyberwar*. <http://www.wired.com/2013/06/general-keith-alexander-cyberwar/all/> Wired December 6.
- Barthes, R. (1967). *The death of the author*. Aspen.
- Bernauer, J., & Pohl, R. (2014). The Proton Radius Problem. *Scientific American*, February, 32–39.
- Black, F., & Scholes, M. (1973). The pricing of options and corporate liabilities. *Journal of Political Economy*, 81(3), 637–654.
- Blaser, M. (2014a). *Missing microbes: How killing bacteria creates modern plagues*. Oxford: OneWorld.
- Blaser, M. (2014b). How antibiotics are making the whole world ill. *The Observer*, June 1.
- Braconier, H., Nicoletti, G., & Westmore, B. (2014). *Policy challenges for the next 50 years*. Paris: OECD.
- Braidotto, R. (2013). *The posthuman*. Oxford: Policy Press.
- Broad, W. J. (2014). Face of science is reshaped by billionaires. *The New York Times*, March 23.
- Butler, D. (2013). When Google got flu wrong. *Nature*, 494(February 13), 155–156.
- Caplan, A. (2010). Life designed to order. *Scientific America*, September, 75.
- CBS News (2010). Hillary Clinton: Qur’an burning not American way. *CBS News*, September 8. <http://www.cbsnews.com/news/hillary-clinton-quran-burning-not-american-way/>
- Chulow, M. (2014). The Isis offensive aims to split Syria in two. *The Guardian*, August 23, 4.
- Cole, S. (2011). Alliterative logic: A theory of postnormal times. *Futures*, 43(March (2)), 209–215.
- Cubitt, S., Hassan, R., & Volkmer, I. (2010). Postnormal network futures: A rejoinder to Ziauddin Sardar. *Futures*, 42, 617–624.
- Curtzen, P. J. (2002). Geology of mankind. *Nature*, 415, 23.
- Danahar, P. (2014). *The New Middle East*. London: Bloomsbury.
- Davies, M. W. (2011a). Guest (Ed.), *Futures*, 43(Special Issue (2)), 136–227.
- Davies, M. W. (2011b). Postnormal Times: Are we there yet? *Futures*, 43(March (2)), 136–141.
- Ellis, W. (2014). The man whose comics predict the future. *Stuff*, October, 44.
- Gabbat, A. (2013). New York woman visited by police after researching pressure online. *The Guardian*, August 1.
- Galbraith, J. (2014). *End of normal: The great crisis and the future of growth*. New York: Simon and Schuster.
- Gary, J. E. (2011). Toward a new macrohistory: An extension to Sardar’s ‘postnormal times’. *Futures*, 43, 48–51.
- Gehmann, U. (2014). The frame context. In U. Gehmann & M. Reiche (Eds.), *Real virtuality*. Bielefeld: Transcript.
- Gidley, J. M. (2010). Postformal priorities for postnormal times: A rejoinder to Ziauddin Sardar. *Futures*, 42, 625–632.



- Goldenberg, S. (2014). Why Global Water Shortages Pose Threat of Terror and War. *The Observer*, February 9, 29–31.
- Graham, J. (2014). Hey, thanks for sharing, but this has gone too far. *Evening Standard*, May 2. (op ed).
- Grantham, J. (2012). On the road to zero growth. *GMO Quarterly Letter*, November. <http://www.cfa-sf.org/files/Grantham%20letter%20Nov%2020.pdf>
- Greenfield, S. (2014). *Mind change*. London: Rider.
- Harding, L. (2014). *The Snowden Files*. London: Guardian Faber Publishing.
- Harris, M. (2014). *The end of absence: Reclaiming what we've lost in a world of constant connection*. New York: Current.
- Harvey, D. (2014). *Seventeen contradictions and the end of capitalism*. London: Profile Books.
- Healy, S. (2011). Postnormal science in postnormal times. *Futures*, 43(March (2)), 202–208.
- Jacobson, R. (2014). Something is seriously wrong on the east coast—and it's killing all the baby puffins. *Mother Jones*, May–June.
- Kapoor, R. (2011). Is there a postnormal time? From the illusion of normality to the design for a new normality. *Futures*, 43, 216–220.
- Kissinger, H. (2014). *World order: Reflections on the character of nations and the course of history*. London: Allan Lane.
- Kolbert, E. (2014). *The sixth extinction*. London: Bloomsbury.
- W. Krauss, M. S. Schäfer, H. von Storch (Eds.). (2012). *Nature and Culture*, 7(Summer (2)).
- Kurzweil, R. (2006). *The singularity is near*. London: Penguin.
- Lapavistas, C. (2013). *Profiting without producing: How finance exploits US all*. London: Verso.
- Laugharne, R., & Laugharne, J. (2002). Psychiatry, postmodernism and postnormal science. *J. R. Soc. Med.*, 95(4), 207–210.
- Leigh, D., & Harding, L. (2013). *WikiLeaks: Inside Julian Assange's War on Secrecy*. London: Guardian Faber Publishing.
- Leppard, D. (2013). Crystal ball cops halt the crimes of tomorrow. *The Sunday Times*, September 29.
- Lewis, M. (2014). *Flash Boys*. London: Allan Lane.
- Lummis, D. (2002). Political theory: Why it seems universal, but isn't really. *Futures*, (February (34)), 63–73.
- Lunau, K. (2014). B.C. starfish are dissolving into goo, and no one knows why. *Macleans*, June 13.
- Luyendijk, J. (2013). *Our banks are not merely out of control. They're beyond control*. 19 June.
- Lykken, J., & Spiropulu, M. (2014). Supersymmetry and the Crisis in Physics. *Scientific American*, 310(May (5)).
- Martinez-Alier, J. (2002). *The environmentalism of the poor: A study of ecological conflicts and valuation*. London: Edwards Elgar.
- Mason, P. (2014). Striking Chinese workers are using 21st-century tools to fight poverty and sweat labour. *The Guardian*, G2, September 15.
- Mayer-Schonberger, V., & Cukier, K. (2013). *Big data: A revolution that will transform how we live, work and think*. London: John Murry.
- Mckie, R. (2014). How long before the ocean claims Miami? *The Observer*, August 3, 20–22.
- Mills, E. (2013). Generation Porn. *The Sunday Times*, News Review, June 16.
- Montuori, A. (2011). Beyond postnormal times: The future of creativity and the creativity of the future. *Futures*, 43(March (2)), 221–227.
- Montuori, A., & Donnelly, G. (2014). Come together. . .for what? Creativity and leadership in postnormal times. *East-West Affairs*, January 5.
- More, M., & Vita-More, N. (Eds.). (2013). *The Transhumanist reader*. New York: Wiley and Sons.
- Morozov, E. (2013). *To save everything click here*. London: Penguin.
- Naomi Klein (2014). *This changes everything*. New York: Simon and Schuster.
- Naughton, J. (2014). We're all being mined for data – but who are the real winners. *The Observer*, June 8.
- O'Connor, M. (2000). Pathways for environmental valuation: A walk in the (hanging) gardens of Babylon. *Ecological Economics*, 34(2), 175–194.
- New Internationalist (2013a). The feral rich. *New Internationalist*, January.
- New Internationalist (2013b). Where have all the girls gone? *New Internationalist*, October.
- Ofcom (2014). *Children and parents: Media use and attitudes in the nations*. London: Ofcom, <http://stakeholders.ofcom.org.uk/market-data-research/other/research-publications/childrens/attitudes-nations/>
- Paul Krugman (2013). *End this depression now*. New York: WW Norton.
- Piketty, T. (2014). *Capital in the twenty-first century* (A. Goldhammer, Trans.) Boston: The Belknap Press.
- Post Normal: <http://post-normal.bandcamp.com..>
- Ravetz, J. R. (2013). The Structure of Science in Postnormal Age. *East-West Affairs*, July 3–4.
- Ravetz, J. (2004). The post-normal science of precaution. *Futures*, 36(3), 347–357.
- Ravetz, J. R., & Funtowicz, S. O. (1994). Emergent complex systems. *Futures*, 26(6), 568–582.
- Ravetz, J. R., & Funtowicz, S. O. (1999). Postnormal science: An insight now maturing. *Futures*, 31(7), 641–646.
- Sabir, R. (2011). I won terror compensation, but my struggle for justice continues. *The Guardian*, Comment is Free, September 19. <http://www.theguardian.com/commentisfree/2011/sep/19/terror-compensation-police-university>
- Sardar, Z. (2010). Welcome to Postnormal Times. *Futures*, 42(June (5)), 435–444.
- Sardar, Z. (2013a). Editorial: East-west in Postnormal Times. *East-West Affairs* 1, January 3–12.
- Sardar, Z. (2013b). The Future of Arab Spring in Postnormal Times. *American Journal of Islamic Social Sciences*, 30(Fall), 125–136.
- Sardar, Z. (2013c). *Future: All that matters*. London: Hodder and Stoughton.
- Sardar, Z., & Yassin-Kassab, R. (2014). *Critical Muslim 11: Syria*. London: Hurst.
- Schwartz, B. (2014). Just say yes. *Democracy*, 33(Summer), 115–120.
- Serra, J. (2014). Postnormal governance. *East-West Affairs*, October 5, 5–13.
- Simon, D. (2013). There are two Americas. My country is a horror show. Capitalism is not a blueprint for building a society. *The Observer 'In focus'*, December 8.
- Singer, N. (2014). Never forgetting a face. *New York Times International Weekly* 8, June 2.
- Slaughter, R. (2011). *The biggest wakeup call in history*. Brisbane: Foresight International.
- Smith, A. (2014). What Just Happened. *The Guardian Weekend*, June 7, 23–33.
- Steffey, G. B. (2013). The Postnormal Lady in Red. *East-West Affairs* 2, April 5–11.
- Stevenson, T. (2013). Yolanda's Colour. *East West Affairs* 3, July–September 21–28.
- Sweeny, J. (2013). Signs of Postnormal Times. *East-West Affairs*, July 3–4, 5–12.
- Sweeny, J. (2014). Command-and-control: Alternative futures of geoengineering in an age of global weirding. *Futures*, 57, 1–13.
- Travis, A., & Arthur, C. (2014). Europe upholds 'right to be forgotten'. *The Guardian*, May 14.
- Venter, C. (2013). *Life at the speed of light*. London: Abacus.
- Walsh, B. (2014). Invasive species. *Time*, 184(July (4)), 20–26.
- Whitehead, F. (2012). (Post normal) cultural heritage. Materials Architecture Design Environment (MADE), Wesleyan Student Assembly.
- Whitehead, F. (2013). *Post normal art* (March 13). The Schuylkill Centre, Environmental Art Department, <http://www.schuylkillcenter.org/art/?p=705>
- WHO (2014). *Antimicrobial resistance: Global report on surveillance*. Geneva: World Health Organisation.
- Yousafzai, M. (2013). *I am Malala*. London: Weidenfeld and Nicolson.