

## Technology and Global Change

# A Delusion of Control: Loss of Agency in Modern Complex Systems

Miguel A. Centeno<sup>1</sup>, Peter W. Callahan<sup>2</sup><sup>a</sup>, Paul Larcey<sup>2</sup>, Thayer S. Patterson<sup>2</sup>

<sup>1</sup> Department of Sociology; School of Public and International Affairs; PIIRS Global Systemic Risk, Princeton University, Princeton, NJ, US, <sup>2</sup> PIIRS Global Systemic Risk, Princeton University, Princeton, NJ, US

Keywords: global systemic risk, complex adaptive systems, CAS, fragility, resilience, systems-of-systems, global networks, self-organized networks, feedback loops, cascades, networks, globalization, illusion of control, adaptive governance, tipping points

<https://doi.org/10.1525/gp.2024.117309>

## Global Perspectives

Vol. 5, Issue 1, 2024

Modern life is in many ways defined by how humans across the world are highly interconnected—and interdependent—through complex global systems. These technologically advanced systems satisfy critical needs through large-scale global networks of communication, transportation, food, healthcare, energy, manufacturing, and finance. The structure and dynamics of these self-organized networks—or complex adaptive systems (CAS)—are studied to analyze systemic fragility and resilience. As we increasingly rely on these globalized CAS, we surrender more and more individual autonomy and agency, diminishing our ability to actually control our outcomes and wellbeing.

In this paper, we discuss how the illusion that we as individuals—or even as a society—can fully control the modern complex systems-of-systems that enable modern living is a dangerous optimism bias. However, the anxiety that comes from supplanting this illusion with a diminished sense of control and autonomy, and the resignation that the world is unpredictable, chaotic, and random is an unsatisfying alternative. Instead, we advocate for greater study and understanding of these systems and for the design of governance paradigms that employ the lenses of complexity, global systemic risk, and our inexorable interdependence. Advancements in this research area would enable both individuals and policy-makers to more effectively navigate the complex systems-of-systems that define globalization, with the goal of restoring a greater sense of agency and control in an uncertain world.

## INTRODUCTION

*And God said, "Let us make humankind in our image, according to our likeness; and let them have dominion over the fish of the sea, and over the birds of the air, and over the cattle, and over all the wild animals of the earth, and over every creeping thing that creeps upon the earth." (Genesis 1:26)*

Despite the ancient mandate from Genesis, control of the earth and everything on it has eluded humanity for millennia. While it is estimated that less than 3 percent of the earth's land surface remains "faunally intact"—defined as being habitat in which all expected species remain with proper abundance and interaction—the 97 percent that *has* been altered by humanity looks very little like "dominion" or control (Plumptre et al. 2021). Fisheries we thought we understood collapse, species we try to keep alive go extinct, and even infrastructure we thought to be robust is vulnerable to natural disasters (Finley 2011; Ludy and Kondolf 2012; Pievani 2014).

Mirroring the uncontrollability of species and the biosphere are the global systems that enable life in the modern world—systems such as energy, internet, finance, manufacturing and trade, transportation, telecommunication, health care and epidemiology, and water and agriculture, among others. These systems are complex and expansive in their own right but also combine, integrate, and interact with one another and the environment across various spatial and temporal scales. These connected systems create systems-of-systems that are even more complex, intractable, and, most importantly, largely uncontrollable.

The literature on the subject has long shown that humans can be quite bad at judging their level of "control" over a situation or an outcome (Langer 1975; Thompson et al. 1993). Games of chance are mistaken for those of skill, correlation is confused with causation, and cognitive biases toward optimism motivate people to misjudge their power to impact a result or mitigate a risk. The dangers of an "illusion of control"—the inclination to overestimate one's ability to influence outcomes—are well-known as gamblers lose

<sup>a</sup> Corresponding author: Peter W. Callahan, [pwcallah@princeton.edu](mailto:pwcallah@princeton.edu)

fortunes, financial systems face ruin, and military generals meet their Waterloo (Thompson 1999). What is less explored, however, are the consequences of the dissolution of this belief or illusion: what are the dangers associated with people seeing how little control they actually have? A sense of control—motivated by either illusory control or real control—is valuable for decision-making under uncertainty, and can inspire the optimism necessary to take risks and innovate (Thompson et al. 1993). Conversely, losing this sense of control can create debilitating risk aversion and anxiety, arresting the progress toward innovation and advancement (Ottesen and Grønhaug 2005; Harris and Osman 2012).

In this essay, we will begin with a description of a modern paradox in which positive metrics for global quality of life have increased but so, too, have rates of anxiety and depression (O’Leary 2021; Santomauro et al. 2021; WHO 2022a). We then discuss how modernity is enabled through a vast network of complex adaptive systems, which are self-organizing and operate beyond the control of any individual or entity. Next, we discuss the human need for (perceived) control and argue that fragilities in the opaque and inescapable systems we rely upon have tempered human agency in the modern world. We show how membership in—and reliance upon—these systems exposes us to perilous consequences of risk and contagion from others. While it may be comforting to continue the legacy belief that we—as individuals and as a society—are in control, the reality is that both the increasing understanding of risk and the awareness of intractable systemic effects have begun to expose this belief in control as a collective illusion. We posit that recent events highlight our helplessness and dispel the myth that either individual actors, or even those tasked with maintaining the functional operations of systems, are fully capable of pulling the strings. Finally, through the lens of complex adaptive systems and global systemic risk, we offer insights and governance strategies for managing resilience and mitigating systemic risk, with the goal of reducing the uncertainty that each of us faces and restoring greater levels of control.

## THE PARADOX OF MODERN GLOBAL SYSTEMS

While global events like the COVID-19 pandemic, the Russian invasion of Ukraine, and conflict in the Middle East have disrupted some positive trends in recent years (FAO et al. 2022; Schöley et al. 2022), there is little doubt that humans in the twenty-first century are far better off than at any other point in history (Pinker 2011; Roser 2020). Though not perfect, this century has seen—and is projected to see—the consistent setting of new high-water marks in metrics like literacy (World Bank 2022; World Economic Forum 2022), life expectancy (Heuveline 2022),<sup>1</sup> reduced infant mortality (Sharrow et al. 2023), per capita GDP (IMF 2023), food security (Zereyesus et al. 2022), and access

to—and affordability of—telecommunication technologies (ITU 2021).

Despite these trends and evidence that by many metrics, global quality of life in modern society is materially “better” than at any other point in human history, mental health has been on the decline worldwide (Goodwin et al. 2022; World Economic Forum 2018). This worrisome trend has developed over recent decades, and in the last several years alone, rates of depression and anxiety increased by over 25 percent (WHO 2022b). In the United States and elsewhere in the developed world, these symptoms have led to “deaths of despair,” whereby alcoholism, other addictions, and suicide have become leading causes of mortality for young working-class individuals (Case and Deaton 2015, 2021).

As we will show below, research identifies agency and a sense of control as critical ingredients to a population’s well-being. We propose that a contributing factor to this global decline in mental health—despite the quality-of-life improvements—is a growing perception of lost control and the conscious or unconscious realization that our autonomy, personal agency, and sense of security are threatened by the realities of globalized and interconnected modern life.

We posit that the erstwhile illusion of control has been attenuated by two factors. First, inaccurate *perception* of control—*irrational* overconfidence—may have declined as delusions have been replaced by knowledge, education, and humbling self-awareness of the limits of our own control (Bernstein 1996). Evolving understanding of probability, accelerating abundance of information and data, and the exponential growth of computing power have provided greater clarity around risk and uncertainty (Arrow 1996; Klir 2006; Lanzetta and Driscoll 1968; Peterson and Pitz 1988). This phenomenon is apparent as probability analyses have become ubiquitous and increasingly integral to modern advancements like navigation software, financial portfolio management, and meteorology, and even in less critical areas such as sabermetrics and other sports analytics (Markowitz 1952; Bar-Shalom, Li, and Kirubarajan 2002; Šarčević et al. 2021; Gallian 2010). Second, when we study the global systems that support our lives, we see that the locus of control has shifted outward from autonomy and autarchy into the system. As this devolution toward the system diminishes our *actual* level of control over our well-being, our *rational* sense of agency thus progressively declines. Current events provide frequent reminders that our growing dependence on the increasingly technological global systems-of-systems is undeniably reducing our individual agency (Newnam and Goode 2015; Dalcher 2007; Funtowicz and Ravetz 1994).

<sup>1</sup> The COVID-19 pandemic caused the first decline in global life expectancy since the worldwide estimates began in 1950 (Heuveline 2022).

## COMPLEX ADAPTIVE SYSTEMS

The benefits of modern society have been made possible, in large part, by the massive global complex adaptive systems (CAS) that enable the continuous flow of information, money, goods, services, and people around the world. These aforementioned systems of energy exploration and production, electricity transmission, computer networks, health care, food and water supplies, transportation networks, commerce, and finance, among others, facilitate our contemporary way of life but also introduce layers of uncertainty and unpredictability. While global interconnectivity is not new, the current “Digital Age of Globalization” is unique for the sheer scale, tight coupling, high levels of interdependence, and instantaneous characteristics of these modern networks (Sachs 2020).

As dynamic global systems grow in their numbers of nodes and links, they become CAS, which are self-organizing with collective behaviors that cannot be reduced to the sum of their individual components. Additionally, CAS are decentralized, are constantly evolving, and can behave in ways that are unpredictable and nonlinear (Holland 1992; Miller and Page 2007). New emergent properties take shape, with systemic characteristics like tipping points, feedback loops, contagion, cascades, and synchronous failures adding layers of complexity to the structure and dynamics of the intricate web that supports modern lifestyles (Centeno et al. 2023a).

Complexity has been a natural consequence of specialization of labor, which has enabled the assembly of increasingly smaller and more technical parts to create advanced technologies. Adam Smith’s description of the division of labor that allowed a pin factory to achieve greater output was a parable of increasing economic complexity (Smith 1776). As individual economic actors moved away from self-reliance to systems of barter, exchange, and commerce, full control over their well-being was gradually traded for the benefits of this greater productivity (Becker and Murphy 1992). Specialization and division of labor allowed for greater innovation and complexity of design, with parts and inputs now sourced through highly complex supply chains, and with efficiency managed increasingly toward the goal of just-in-time inventory (Yang and Sachs 2003; Ibrahim et al. 2021).

Similarly, the benefits of economies of scale and technological advancement have shifted greater power into the hands of a small number of large companies. For example, it is estimated that as of 2023, Taiwan Semiconductor Manufacturing Company (TSMC) supplied up to 56 percent of the global semiconductor market (International Data Corporation 2023), and some estimates of Apple’s US market share of smartphones are as high as 55 percent (Counterpoint Research 2023). In the financial sector, the consolidation of banks and the moral hazard of government bailouts has increasingly concentrated US deposits, with the top four banks accounting for 24 percent of total assets of financial institutions (Statista 2023).

These seemingly abstract concepts of specialization and complexity had harsh concrete manifestations during the

COVID-19 pandemic. Global demand created disruptions in supply chains for personal protective equipment (PPE) at the time of greatest need (Cohen and Rodgers 2020). Similarly, supply chain shocks from lockdowns created a shortage of semiconductor chips that held up the manufacturing of automobile assembly lines (Ewing and Boudette 2021), while millions were affected by job loss and business closures (Naseer et al. 2023).

These systemic effects on both health and commerce—all of which were outside the scope of control for those most affected—began with a localized health crisis in China and quickly propagated around the world, creating cascades and contagions through the global systems-of-systems. Beyond the pandemic, examples of systemic global disruptions are alarmingly frequent and costly (WEF 2023). A ship run aground in the Suez Canal delays global cargo for weeks (Lee and Wong 2021), an uncharacteristically cold February in Texas leaves millions without power (Flores et al. 2023), and a dictator’s decision to invade a neighboring country sends food and energy prices soaring around the world (Hendrix 2022).

In short, life in the modern Digital Age of Globalization means that individuals (whether they want to or not) find themselves at the mercy of systems and sprawling institutions that are impossible to fully understand, much less fully control. As described by Anthony Giddens, “no one can completely opt out of the abstract systems involved in modern institutions,” and we find ourselves putting more and more trust in esoteric “experts” who may or may not have things in hand (Giddens 1990, 84). Giddens goes on to liken modern life to a ride “aboard a careering juggernaut” that does not take orders or direction and can hardly be influenced by its passengers (Giddens 1990, 53).

## CONTROL AND WELL-BEING

Whether the ability to direct this juggernaut exists or not, there is little doubt that *belief* in our own agency and control over our environment is critical for human well-being (Chorpita and Barlow 1998; Kay et al. 2009; Langer and Rodin 1976). Research suggests that humanity is hardwired to seek out a feeling of control (Leotti, Iyengar, and Ochsner 2010) and shows that when outcomes feel governed by randomness or chaos instead of by deliberate action, fears from the inherent uncertainty increase levels of depression and anxiety with potentially long-term consequences for mental and physical health (Tullett, Kay, and Inzlicht 2015).

As the world gives us more reasons to doubt possible control, some seek comfort in conspiracy theories (van Prooijen and Acker 2015; van Prooijen and Douglas 2017). A conspiracy that someone—even if that someone is a bad actor—has a plan and the ability to execute it can be reassuring. As individuals become more affected by global systems and distant events beyond their personal agency, a conspiracy theory offering explanatory power and determinism is more attractive than the confusion of complexity and randomness. These theories thrive and grow in popularity during periods when feelings of helplessness, anxiety,

and loss of control increase as well—essentially replacing one illusion of control for another (Douglas et al. 2019).

It is clear that humans do better when we believe we have agency (Taylor and Brown 1988). As noted above, however, we each depend on a system-of-systems—composed of the CAS that provide our daily necessities—over which we have very limited control. As fragilities in these systems become exposed, the belief in our agency becomes harder and harder to maintain. Global events like the financial crisis of 2008–9, COVID-19, climate change, and geopolitical conflict are all stark reminders of how little control we have over dramatic shifts that profoundly impact our daily lives. Like Ulrich Beck’s description of a blade of grass in Bavaria, whose life “ultimately comes to depend on the making and keeping of international agreements,” we find ourselves increasingly at the mercy of forces far beyond our abilities to influence (Beck 1992, 23). For the vast majority of us, everyday necessities like food, water, electricity, credit cards, and even smartphones rely upon networks that we couldn’t “fix” if they were to be disrupted. Those of us who depend on these modern systems are beginning to realize that we might not be in the driver’s seat. More worrisome still is the question (to continue the metaphor): is there *anyone* in the driver’s seat? And even if there were, is there any way of knowing whether the steering wheel itself is even connected at all?

Scholarship on civilizational collapse shows that this increasing loss of control in complex societies is a recurring phenomenon, which can precipitate fatal consequences for civilizations (Gibbon 1788; Tainter 1988, 1995). Recent studies of this historical pattern have addressed how increasing connectivity and interdependence of previously autonomous agents initially contribute to the growth phase of civilization, while late-stage fragilities and collapse are often associated with unwieldy complexity, excessive levels of dependence, and the eventual inexorable loss of agency and control (Bookstaber 2023; Sandberg 2023; Tainter 2014). This loss of control is often masked by the illusion that tomorrow will be just like yesterday, and ultimately contributes to diminished resilience and the unraveling of societies (Centeno et al. 2023b). Throughout history, the illusion of being able to control complex adaptive systems has allowed the confidence and optimism to take the risks necessary for societies to grow and flourish (Heunks 1998; Rigotti, Ryan, and Vaithianathan 2011). Yet the hindsight of civilizational collapse exposes this illusion as a dangerous delusion, much like the hubris of Shelley’s Ozymandias.

## GOVERNING COMPLEXITY AND RECLAIMING CONTROL: A SYSTEMS APPROACH

What can be done to establish critical aspects of control—genuine empowerment and meaningful management—of the global systems that we rely upon daily? The first important tool we discuss is governance: critical to the sustainable functioning and operation of complex systems. Like a governor on an engine, which limits speed within tolerance levels, governance is synonymous in many ways with *control* and can be essential to establishing the pa-

rameters within which the structure and dynamics of CAS take shape.

Given that even one CAS alone is far too dynamic and unpredictable to fully control, the prospect of governing an interconnected network of multiple such systems is even more intractable. Effective governance in this context is considered to be the most challenging type of “wicked problem,” where goals are difficult to define, progress is elusive to test, and solutions that prove effective in one scenario cannot be widely applied more generally to others (Rittel and Webber 1973; DeFries and Nagendra 2017; Heifetz 1994). The wickedness of this challenge—and what we know about CAS—means that it will never be possible to restore full confidence and individual agency within these unwieldy systems, but some governance strategies and principles may help provide greater capacity for adaptation as well as systemic reliability, stability, and resilience.

Often overlooked in discussion of governance is that responsible self-governance—greater control in the form of risk management by the members of the systems—provides an important foundation for systemic resilience (Espinosa 2022). As individuals and entities, the self-organizing nodes linked together in the network benefit from systemic efficiency, trading the control, autonomy, and risks of self-reliance for the advantages, efficiencies, and *other* risks of dependence upon the system (Ostrom 2015; Espinosa and Guzman 2015). As interdependent nodes take on greater systemic risk, the potential for a dangerous positive feedback loop develops: weak nodes create a fragile system, and a fragile system further threatens the stability of nodes. Vulnerabilities appear, as exogenous shocks have greater potential to trigger the cascading failure of nodes and links, precipitating systemic collapse (Crucitti, Latora, and Marchiori 2004; Ash and Newth 2007).

Both the financial crisis of 2008–9 and the COVID-19 pandemic exposed the ways in which many individuals and entities participating in systems had abdicated their bottom-up governance, trading their fiduciary obligations of prudence for the benefits of efficiency and risk (Bender et al. 2022; Quételet et al. 2022). The safety and security of stockpiling reserves have been supplanted by the convenience of modern systems. Households are increasingly managed with just-in-time inventory: ordering a battery to be shipped the same day or having meals delivered to the doorstep (Kassas and Nayga 2021). In this way, households have followed businesses in opting for the convenience and financial benefits of on-demand purchasing, just-in-time inventory, and consumer debt (Vermeulen 2015). This shift has led to a decline in resilience in both companies and households, which live at the margin by forgoing reserves, redundancies, buffers, diversification of suppliers, and rainy-day funds (Lusardi, Schneider, and Tufano 2011), drawing us closer to the apocryphal adage that “civilization is three meals away from anarchy.”

It is important to note, however, that systemic risk and endogenous failures can manifest even when all individual nodes *are* prudently self-governed and careful about their own individual exposures. The principle of emergence tells us that systems might produce outcomes predicated not

on the actions of their individual parts but rather on their interactions (Centeno et al. 2015). For example, we might monitor the quality of apples to make sure no bad fruit infects the entire basket, but perhaps the problem is not an individual rotten apple but the very co-presence of so many apples that precipitates spoilage. A systemic view of risk management, therefore, is critical for long-term stability, and complete dependence on bottom-up strategies will not effectively restore resilience and the confidence of control that comes with it (Chambers et al. 2019).

At the other end of the governance spectrum, top-down approaches can be valuable in certain contexts. For example, in “tragedy of the commons” scenarios such as natural resource depletion, electrical grid blackouts, and water scarcity, the aggregation of self-interested individual choices can overwhelm systemic integrity, requiring oversight. Top-down governance is also relevant within systems that prioritize safety, such as air traffic control and nuclear power. Intervention can take various forms, such as designing architecture of systems for robustness and resilience, actively monitoring and regulating the stability of systemic structure and dynamics, stress testing, and directing the recovery following systemic failure. Examples of top-down systemic interventions include stock markets with “circuit breakers” to stop feedback loops and panics (Sifat and Mohamad 2019), electrical grids implementing rotating power outages to manage load (Menati and Xie 2021; Wang, Hong, and Li 2021), and disaster recovery by FEMA (Olshansky and Johnson 2014). Top-down strategies can also be effective at identifying and making use of “leverage points” to make significant change to system behavior through minor intervention (Meadows 2008). A danger here, however, is that once these levers are identified, there is substantial risk that they could be pushed for change in the wrong direction (Forrester 1971, 1968).

In this way, top-down intervention can create potential for significant unintended consequences that reduce resilience and erode a sense of individual agency and control. Within the financial system, for example, the possibility of top-down governance intervention—in the form of government bailouts—has incentivized institutions to abdicate bottom-up self-governance as banks take larger risks to achieve economies of scale and global competitiveness (Andersen and Jensen 2022; Mishkin 2006). These selective governance interventions have inadvertently concentrated market share in the hands of a smaller number of large “too big to fail” banks, as assets are siphoned away from smaller banks where depositors face the risk of not being bailed out (Eufinger, Gorostiaga, and Richter 2023; Davila, Burge, and Hammen 1997). The moral hazard of rescues and bailouts inspired Nassim Taleb to argue that one of the pillars of a “black-swan-robust world” is “no socialisation of losses and privatisation of gains” (Taleb 2009).

The challenge of navigating the wicked problem of complex systems governance requires bespoke management solutions to promote and maintain stability and resilience. Research has advocated for the concept of “adaptive governance” as a potentially effective solution that provides dynamic flexibility while balancing the trade-offs and con-

flicts between bottom-up and top-down, small and large scales, and local and global coordination (Walker and Salt 2012; Carpenter et al. 2009). Evolving from the fields of ecosystem and resource management, the theory of adaptive governance emphasizes nimble, multilevel, and dynamic management that incorporates new information, which feeds back to adjust policy (Folke et al. 2005; Boyd and Folke 2012). Recognizing the various flexible forms and applications of adaptive governance, Chaffin, Gosnell, and Cosens note:

Adaptive governance is an emergent form of environmental governance that cannot be created by a unilateral action of government. Adaptive governance is never the same in two places; it is messy and often develops organically within the context of a social-ecological system, but it can also be encouraged with an intervention aimed at boosting adaptive capacity. It exists across a spectrum, from top-down to bottom-up, from rigid to flexible, from global to local, but never exists at one extreme. (Chaffin, Gosnell, and Cosens 2014, 56)

In contrast, nonadaptive governance styles are fully rigid, unresponsive to change, and struggle to learn from the past and the present. “Indeed, nonadaptive governance of a dynamic system with changing thresholds,” write Walker and Salt, “is bound to fail” (Walker and Salt 2012, 131).

While perhaps simple to discuss in theory, adaptive governance strategies can prove difficult to implement in the real world (Schultz et al. 2015). One reason is that governance systems have themselves become large, unwieldy, and complex, making the prospect of using one complex system to manage others an example of what Galaz calls a challenge of “double complexity” (Galaz 2011). Another challenge relates to how much current models of adaptive governance rely on human relationships and trust (Schultz et al. 2015). Despite these difficulties, the principles of adaptive governance and management are critical to consider if any comfort and confidence are to be restored in the unpredictable and nested complexity of the modern world.

## CONCLUSION

Dependence on the CAS of our modern world has, in many ways, diminished our ability to *actually* control our outcomes and well-being. Further, our rising awareness of these intractable systems has shined a light on our inefficacy, shattering the illusion that we individually have agency to meaningfully affect our globalized and interconnected present. The illusion that we as individuals—or even as a society—can have dominion over the runaway juggernaut that is our modern complex systems-of-systems is a dangerous optimism bias. However, the anxiety that comes from supplanting this illusion with a diminished sense of control and autonomy—and the resignation that the world is unpredictable, chaotic, and random—is an unsatisfying alternative.

In this paper, we connect the negative consequences of feeling out of control to the reality that our CAS-enabled

modernity has eroded human agency. The specialization of our modern world certainly necessitates the concession of some levels of control—we cannot each be our own heart surgeon, car mechanic, pilot, farmer, etc.—but an awareness of our position within the larger system and an increased understanding of how complexity creates vulnerabilities in our lives can be empowering. Through our study of complexity and systemic risk, we can begin to understand the ways in which our autonomy has diminished, and how we might work to reclaim a sense of control.

We illustrate how complete dependence on top-down strategies can make society vulnerable to unintended consequences. We will never understand the systems-of-systems well enough to know exactly which of the countless levers to pull, how far, and for how long, or what intervention is exactly appropriate at any given time. Conversely, a focus on only bottom-up approaches can be limiting and ineffective at taking advantage of larger systemic benefits. We illustrate how many of these challenges are addressed by adaptive governance strategies, which incorporate a more nuanced and flexible approach to these complex dynamic systems. We argue that while certainly not a “silver bullet” to solve all issues of agency and control in CAS, elements of adaptive governance—which should incorporate perspectives from multiple levels of the system, incentivize resilience over efficiency, and foster more confidence in the longevity of shared systemic structures and dynamics—can help guide our modern systems toward more stability. Designing governance paradigms that employ the lens of complexity, global systemic risk, and the understanding of inexorable interdependence will allow both individuals and policy-makers to more effectively navigate the complex systems-of-systems that define globalization, restoring a greater sense of agency and control in an uncertain world.

.....

#### COMPETING INTERESTS

The authors have no competing financial or nonfinancial interests to declare. Miguel A. Centeno is the *Global Perspectives* section editor for *Global Epistemologies: Con-*

cepts, Methodologies, and Data Systems. He was not involved in the review process for this article.

#### AUTHOR BIOGRAPHIES

**Miguel A. Centeno** is Musgrave Professor of Sociology at Princeton University and Executive Vice Dean of Princeton University’s School of Public and International Affairs. He is founder and co-director of the Princeton Institute for International and Regional Studies (PIIRS) Global Systemic Risk research community.

**Peter W. Callahan** studied history at Princeton University and earned his MS in geography and environmental studies from the University of New Mexico. He is a researcher at Princeton’s PIIRS Global Systemic Risk research community, where his scholarly interests include the study of socio-ecological systems, historical systemic risks, sustainable development, and renewable energy policy and technology.

**Paul A. Larcey** is co-director of the PIIRS Global Systemic Risk research community at Princeton University. Larcey’s work with the UK’s innovation agency focuses on key emerging technologies including life sciences, quantum technologies, and AI. He has worked in corporate research, venture capital, and global industrial sectors at board and senior levels and studied engineering, materials science, and finance at London, Oxford, and Cambridge Universities.

**Thayer S. Patterson** is coordinator and a founding member of the PIIRS Global Systemic Risk research community at Princeton University. Following his studies in economics and mechanical engineering at Yale, and finance at Princeton’s Bendheim Center for Finance, his research has focused on the causes and consequences of catastrophic systemic risk.

Submitted: February 12, 2024 PDT, Accepted: February 13, 2024 PDT



This is an open-access article distributed under the terms of the Creative Commons Attribution 4.0 International License (CCBY-4.0). View this license’s legal deed at <http://creativecommons.org/licenses/by/4.0> and legal code at <http://creativecommons.org/licenses/by/4.0/legalcode> for more information.



## REFERENCES

- Andersen, Thomas Barnebeck, and Peter Sandholt Jensen. 2022. "Too Big to Fail and Moral Hazard: Evidence from an Epoch of Unregulated Commercial Banking." *IMF Economic Review* 70 (4): 808–30. <https://doi.org/10.1057/s41308-022-00167-7>.
- Arrow, Kenneth J. 1996. "The Economics of Information: An Exposition." *Empirica* 23 (2): 119–28. <https://doi.org/10.1007/BF00925335>.
- Ash, J., and D. Newth. 2007. "Optimizing Complex Networks for Resilience against Cascading Failure." *Physica A: Statistical Mechanics and Its Applications* 380: 673–83. <https://doi.org/10.1016/j.physa.2006.12.058>.
- Bar-Shalom, Yaakov, X.-Rong Li, and Thiagalingam Kirubarajan. 2002. *Estimation with Applications to Tracking and Navigation*. First Edition. New York, NY: John Wiley & Sons.
- Beck, Ulrich. 1992. *Risk Society: Towards a New Modernity*. First edition. London; Newbury Park, CA: SAGE Publications.
- Becker, Gary S., and Kevin M. Murphy. 1992. "The Division of Labor, Coordination Costs, and Knowledge." *The Quarterly Journal of Economics* 107 (4): 1137–60. <https://doi.org/10.2307/2118383>.
- Bender, Kathryn E., Aishwarya Badiger, Brian E. Roe, Yiheng Shu, and Danyi Qi. 2022. "Consumer Behavior during the COVID-19 Pandemic: An Analysis of Food Purchasing and Management Behaviors in U.S. Households through the Lens of Food System Resilience." *Socio-Economic Planning Sciences* 82: 101107. <https://doi.org/10.1016/j.seps.2021.101107>.
- Bernstein, Peter L. 1996. *Against the Gods: The Remarkable Story of Risk*. New York, NY: John Wiley & Sons.
- Bookstaber, Richard. 2023. "From Wild West to Mad Max: Transition in Civilizations." In *How Worlds Collapse: What History, Systems, and Complexity Can Teach Us About Our Modern World and Fragile Future*, First Edition, 333–57. New York, NY: Routledge Press. <https://doi.org/10.4324/9781003331384-22>.
- Boyd, Emily, and Carl Folke. 2012. *Adapting Institutions: Governance, Complexity, and Social-Ecological Resilience*. New York: Cambridge University Press. <https://doi.org/10.1017/CBO9781139017237>.
- Carpenter, Stephen R., Carl Folke, Marten Scheffer, and Frances Westley. 2009. "Resilience: Accounting for the Noncomputable." *Ecology and Society*. <https://doi.org/10.5751/ES-02819-140113>.
- Case, Anne, and Angus Deaton. 2015. "Rising Morbidity and Mortality in Midlife among White Non-Hispanic Americans in the 21st Century." *Proceedings of the National Academy of Sciences* 112 (49): 15078–83. <https://doi.org/10.1073/pnas.1518393112>.
- . 2021. *Deaths of Despair and the Future of Capitalism*. Princeton University Press.
- Centeno, Miguel A., Peter W. Callahan, Paul A. Larcey, and Thayer S. Patterson. 2023a. "Globalization and Fragility: A Systems Approach to Collapse." In *How Worlds Collapse: What History, Systems, and Complexity Can Teach Us About Our Modern World and Fragile Future*, First Edition, 5–24. New York, NY: Routledge Press.
- . 2023b. *How Worlds Collapse: What History, Systems, and Complexity Can Teach Us About Our Modern World and Fragile Future*. First Edition. New York, NY: Routledge Press. <https://doi.org/10.4324/9781003331384>.
- Centeno, Miguel A., Manish Nag, Thayer S. Patterson, Andrew Shaver, and A. Jason Windawi. 2015. "The Emergence of Global Systemic Risk." *Annual Review of Sociology* 41 (1): 65–85. <https://doi.org/10.1146/annurev-soc-073014-112317>.
- Chaffin, Brian C., Hannah Gosnell, and Barbara A. Cosens. 2014. "A Decade of Adaptive Governance Scholarship: Synthesis and Future Directions." *Ecology and Society*. <https://doi.org/10.5751/ES-06824-190356>.
- Chambers, Caitlin, Luca Rade, Thayer Patterson, and Miguel A. Centeno. 2019. "The System Made Me Do It? Regulating Systemic Risk." In *Global Challenges, Governance, and Complexity*, 317. Cheltenham, UK; Northampton, MA: Edward Elgar Publishing. <https://doi.org/10.4337/9781788115421.00021>.
- Chorpita, Bruce F., and David H. Barlow. 1998. "The Development of Anxiety: The Role of Control in the Early Environment." *Psychological Bulletin* 124: 3–21. <https://doi.org/10.1037/0033-2909.124.1.3>.
- Counterpoint Research. 2023. "US Smartphone Shipments Fall 24% YoY in Q2 2023 on Lower Upgrade Rates." Counterpoint Research.
- Crucitti, Paolo, Vito Latora, and Massimo Marchiori. 2004. "A Model for Cascading Failures in Complex Networks." *Physical Review E* 69 (4): 045104. <https://doi.org/10.1103/PhysRevE.69.045104>.
- Dalcher, Darren. 2007. "Why the Pilot Cannot Be Blamed: A Cautionary Note about Excessive Reliance on Technology." *International Journal of Risk Assessment and Management* 7 (3): 350–66. <https://doi.org/10.1504/IJRAM.2007.011988>.
- Davila, Joanne, Dorli Burge, and Constance Hammen. 1997. "Why Does Attachment Style Change?" *Journal of Personality and Social Psychology* 73: 826–38. <https://doi.org/10.1037/0022-3514.73.4.826>.
- DeFries, Ruth, and Harini Nagendra. 2017. "Ecosystem Management as a Wicked Problem." *Science* 356 (6335): 265–70. <https://doi.org/10.1126/science.aal1950>.
- Douglas, Karen M., Joseph E. Uscinski, Robbie M. Sutton, Aleksandra Cichocka, Turkay Nefes, Chee Siang Ang, and Farzin Deravi. 2019. "Understanding Conspiracy Theories." *Political Psychology* 40 (S1): 3–35. <https://doi.org/10.1111/pops.12568>.

- Espinosa, Angela. 2022. *Sustainable Self-Governance in Businesses and Society: The Viable System Model in Action*. Oxford, New York: Taylor & Francis. <https://doi.org/10.4324/9780429490835>.
- Espinosa, Angela, and David Guzman. 2015. "Self-Governance and Symbiosis: A Systemic Approach to Socio Ecological Systems Resilience." *Proceedings of the 59th Annual Meeting of the ISSS – 2015 Berlin, Germany* 1 (1).
- Eufinger, Christian, Juan Pablo Gorostiaga, and Björn Richter. 2023. "Concentrating on Bailouts: Government Guarantees and Bank Asset Composition." Rochester, NY: SSRN Scholarly Paper. <https://doi.org/10.2139/ssrn.4522039>.
- Ewing, Jack, and Neal E. Boudette. 2021. "A Tiny Part's Big Ripple: Global Chip Shortage Hobbles the Auto Industry." *The New York Times*, April 23, 2021, sec. Business.
- FAO, IFAD, UNICEF, WFP, and WHO. 2022. "The State of Food Security and Nutrition in the World 2022: Repurposing Food and Agricultural Policies to Make Healthy Diets More Affordable. The State of Food Security and Nutrition in the World (SOFI) 2022." Rome, Italy: FAO, IFAD, UNICEF, WFP, WHO.
- Finley, Carmel. 2011. *All the Fish in the Sea: Maximum Sustainable Yield and the Failure of Fisheries Management. Illustrated Edition*. Chicago: University of Chicago Press. <https://doi.org/10.7208/chicago/9780226249681.001.0001>.
- Flores, Nina M., Heather McBrien, Vivian Do, Mathew V. Kiang, Jeffrey Schlegelmilch, and Joan A. Casey. 2023. "The 2021 Texas Power Crisis: Distribution, Duration, and Disparities." *Journal of Exposure Science & Environmental Epidemiology* 33 (1): 21–31. <https://doi.org/10.1038/s41370-022-00462-5>.
- Folke, Carl, Thomas Hahn, Per Olsson, and Jon Norberg. 2005. "Adaptive Governance of Social-Ecological Systems." *Annual Review of Environment and Resources* 30: 441–73. <https://doi.org/10.1146/annurev.energy.30.050504.144511>.
- Forrester, Jay W. 1968. *Principles of Systems*. Arcadia, CA: Pegasus Communications.
- . 1971. "Counterintuitive Behavior of Social Systems." *Theory and Decision* 2 (2): 109–40. <https://doi.org/10.1007/BF00148991>.
- Funtowicz, Silvio, and Jerome R. Ravetz. 1994. "Emergent Complex Systems." *Futures, Special Issue on "Complexity: Fad or Future?"*, 26 (6): 568–82. [https://doi.org/10.1016/0016-3287\(94\)90029-9](https://doi.org/10.1016/0016-3287(94)90029-9).
- Galaz, Victor. 2011. "Double Complexity: Information Technology and Reconfigurations in Adaptive Governance." In *Adapting Institutions: Governance, Complexity and Social-Ecological Resilience*, edited by Emily Boyd and Carl Folke. Cambridge: Cambridge University Press. <https://doi.org/10.1017/CBO9781139017237.014>.
- Gallian, Joseph A. 2010. *Mathematics and Sports*. Mathematical Association of America.
- Gibbon, Edward. 1788. *The History of The Decline and Fall of The Roman Empire*. Vol. 6. London.
- Giddens, Anthony. 1990. *The Consequences of Modernity*. Cambridge, UK: Cambridge University Press.
- Goodwin, Renee D., Lisa C. Dierker, Melody Wu, Sandro Galea, Christina W. Hoven, and Andrea H. Weinberger. 2022. "Trends in U.S. Depression Prevalence From 2015 to 2020: The Widening Treatment Gap." *American Journal of Preventive Medicine* 63 (5): 726–33. <https://doi.org/10.1016/j.amepre.2022.05.014>.
- Harris, Adam J. L., and Magda Osman. 2012. "The Illusion of Control: A Bayesian Perspective." *Synthese* 189 (1): 29–38. <https://doi.org/10.1007/s11229-012-0090-2>.
- Heifetz, Ronald A. 1994. *Leadership Without Easy Answers*. Harvard University Press. <https://doi.org/10.4159/9780674038479>.
- Hendrix, Cullen. 2022. "Every Recent Oil and Food Price Shock Bears Putin's Fingerprints." *Foreign Policy* (blog). September 14, 2022.
- Heunks, Felix J. 1998. "Innovation, Creativity and Success." *Small Business Economics* 10 (3): 263–72. <https://doi.org/10.1023/A:1007968217565>.
- Heuveline, Patrick. 2022. "Global and National Declines in Life Expectancy: An End-of-2021 Assessment." *Population and Development Review* 48 (1): 31–50. <https://doi.org/10.1111/padr.12477>.
- Holland, John H. 1992. "Complex Adaptive Systems." *Daedalus* 121 (1): 17–30.
- Ibrahim, Sherwat E., Miguel A. Centeno, Thayer S. Patterson, and Peter W. Callahan. 2021. "Resilience in Global Value Chains: A Systemic Risk Approach." *Global Perspectives* 2 (1): 27658. <https://doi.org/10.1525/gp.2021.27658>.
- IMF. 2023. "World Economic Outlook: GDP per Capita, Current Prices."
- International Data Corporation. 2023. "Worldwide Semiconductor Foundry Market Grew 27.9% YoY in 2022, Projected to Decrease by 6.5% YoY in 2023 Due to Inventory Adjustments." Singapore: International Data Corporation.
- ITU. 2021. "Connectivity in the Least Developed Countries: Status Report 2021." Geneva, Switzerland: United Nations International Telecommunication Union.
- Kassas, Bachir, and Rodolfo M. Nayga. 2021. "Understanding the Importance and Timing of Panic Buying among U.S. Households during the COVID-19 Pandemic." *Food Quality and Preference* 93: 104240. <https://doi.org/10.1016/j.foodqual.2021.104240>.
- Kay, Aaron C., Jennifer A. Whitson, Danielle Gaucher, and Adam D. Galinsky. 2009. "Compensatory Control: Achieving Order Through the Mind, Our Institutions, and the Heavens." *Current Directions in Psychological Science* 18 (5): 264–68. <https://doi.org/10.1111/j.1467-8721.2009.01649.x>.
- Klir, George J. 2006. *Uncertainty and Information: Foundations of Generalized Information Theory*. Hoboken, NJ: Wiley-Interscience. <https://doi.org/10.1002/0471755575>.
- Langer, Ellen J. 1975. "The Illusion of Control." *Journal of Personality and Social Psychology* 32 (2): 311–28. <https://doi.org/10.1037/0022-3514.32.2.311>.



- Langer, Ellen J., and Judith Rodin. 1976. "The Effects of Choice and Enhanced Personal Responsibility for the Aged: A Field Experiment in an Institutional Setting." *Journal of Personality and Social Psychology* 34: 191–98. <https://doi.org/10.1037/0022-3514.34.2.191>.
- Lanzetta, John T., and James M. Driscoll. 1968. "Effects of Uncertainty and Importance on Information Search in Decision Making." *Journal of Personality and Social Psychology* 10 (4): 479–86. <https://doi.org/10.1037/h0026749>.
- Lee, Jade, and Eugene Wong. 2021. "Suez Canal Blockage: An Analysis of Legal Impact, Risks and Liabilities to the Global Supply Chain." *MATEC Web of Conferences* 339: 01019.
- Leotti, Lauren A., Sheena S. Iyengar, and Kevin N. Ochsner. 2010. "Born to Choose: The Origins and Value of the Need for Control." *Trends in Cognitive Sciences* 14 (10): 457–63. <https://doi.org/10.1016/j.tics.2010.08.001>.
- Ludy, Jessica, and G. Matt Kondolf. 2012. "Flood Risk Perception in Lands 'Protected' by 100-Year Levees." *Natural Hazards* 61 (2): 829–42. <https://doi.org/10.1007/s11069-011-0072-6>.
- Lusardi, Annamaria, Daniel J. Schneider, and Peter Tufano. 2011. "Financially Fragile Households: Evidence and Implications." Working Paper Series. National Bureau of Economic Research. <https://doi.org/10.3386/w17072>.
- Markowitz, Harry. 1952. "The Utility of Wealth." *Journal of Political Economy* 60 (2): 151–58. <https://doi.org/10.1086/257177>.
- Meadows, Donella H. 2008. *Thinking in Systems: A Primer*. White River Junction, Vermont: Chelsea Green Publishing.
- Menati, Ali, and Le Xie. 2021. "A Preliminary Study on the Role of Energy Storage and Load Rationing in Mitigating the Impact of the 2021 Texas Power Outage." In *2021 North American Power Symposium (NAPS)*, 1–5.
- Miller, John H., and Scott E. Page. 2007. *Complex Adaptive Systems: An Introduction to Computational Models of Social Life*. Princeton, New Jersey: Princeton University Press.
- Mishkin, Frederic S. 2006. "How Big a Problem Is Too Big to Fail? A Review of Gary Stern and Ron Feldman's Too Big to Fail: The Hazards of Bank Bailouts." *Journal of Economic Literature* 44 (4): 988–1004. <https://doi.org/10.1257/jel.44.4.988>.
- Naseer, Saira, Sidra Khalid, Summaira Parveen, Kashif Abbass, Huaming Song, and Monica Violeta Achim. 2023. "COVID-19 Outbreak: Impact on Global Economy." *Frontiers in Public Health* 10. <https://doi.org/10.3389/fpubh.2022.1009393>.
- Newnam, Sharon, and Natassia Goode. 2015. "Do Not Blame the Driver: A Systems Analysis of the Causes of Road Freight Crashes." *Accident Analysis & Prevention* 76: 141–51. <https://doi.org/10.1016/j.aap.2015.01.016>.
- O'Leary, Karen. 2021. "Global Increase in Depression and Anxiety." *Nature Medicine*, October. <https://doi.org/10.1038/d41591-021-00064-y>.
- Olshansky, Robert B., and Laurie A. Johnson. 2014. "The Evolution of the Federal Role in Supporting Community Recovery After U.S. Disasters." *Journal of the American Planning Association* 80 (4): 293–304. <https://doi.org/10.1080/01944363.2014.967710>.
- Ostrom, Elinor, ed. 2015. "An Institutional Approach to the Study of Self-Organization and Self-Governance in CPR Situations." In *Governing the Commons: The Evolution of Institutions for Collective Action*, 29–57. Canto Classics. Cambridge: Cambridge University Press. <https://doi.org/10.1017/CBO9781316423936.003>.
- Ottesen, Geir Grundvåg, and Kjell Grønhaug. 2005. "Positive Illusions and New Venture Creation: Conceptual Issues and An Empirical Illustration." *Creativity and Innovation Management* 14 (4): 405–12. <https://doi.org/10.1111/j.1467-8691.2005.00360.x>.
- Peterson, Dane K., and Gordon F. Pitz. 1988. "Confidence, Uncertainty, and the Use of Information." *Journal of Experimental Psychology: Learning, Memory, and Cognition* 14 (1): 85–92.
- Pievani, Telmo. 2014. "The Sixth Mass Extinction: Anthropocene and the Human Impact on Biodiversity." *Rendiconti Lincei* 25 (1): 85–93. <https://doi.org/10.1007/s12210-013-0258-9>.
- Pinker, Steven. 2011. *The Better Angels of Our Nature: Why Violence Has Declined*. First Edition. New York: Viking.
- Plumptre, Andrew J., Daniele Baisero, R. Travis Belote, Ella Vázquez-Domínguez, Soren Faurby, Włodzimierz Jędrzejewski, Henry Kiara, et al. 2021. "Where Might We Find Ecologically Intact Communities?" *Frontiers in Forests and Global Change* 4. <https://doi.org/10.3389/ffgc.2021.626635>.
- Prooijen, Jan-Willem van, and Michele Acker. 2015. "The Influence of Control on Belief in Conspiracy Theories: Conceptual and Applied Extensions." *Applied Cognitive Psychology* 29 (5): 753–61. <https://doi.org/10.1002/acp.3161>.
- Prooijen, Jan-Willem van, and Karen M. Douglas. 2017. "Conspiracy Theories as Part of History: The Role of Societal Crisis Situations." *Memory Studies* 10 (3): 323–33. <https://doi.org/10.1177/1750698017701615>.
- Quétel, Christophe R., Guy Bordin, Alexandre Abreu, Ilekttra Lemi, and Carlos Sangreman. 2022. "On the Nature and Determinants of Poor Households' Resilience in Fragility Contexts." *Journal of Human Development and Capabilities* 23 (2): 252–69. <https://doi.org/10.1080/19452829.2021.1929102>.
- Rigotti, Luca, Matthew Ryan, and Rhema Vaithianathan. 2011. "Optimism and Firm Formation." *Economic Theory* 46 (1): 1–38. <https://doi.org/10.1007/s00199-009-0501-x>.
- Rittel, Horst W. J., and Melvin M. Webber. 1973. "Dilemmas in a General Theory of Planning." *Policy Sciences* 4 (2): 155–69. <https://doi.org/10.1007/BF01405730>.
- Roser, Max. 2020. "The Short History of Global Living Conditions and Why It Matters That We Know It." *Our World in Data* (blog). 2020.

- Sachs, Jeffrey D. 2020. *The Ages of Globalization: Geography, Technology, and Institutions. Illustrated Edition*. New York: Columbia University Press.
- Sandberg, Anders. 2023. "The Lifespan of Civilizations: Do Societies 'Age,' or Is Collapse Just Bad Luck?" In *How Worlds Collapse: What History, Systems, and Complexity Can Teach Us About Our Modern World and Fragile Future*, First Edition, 375–96. New York, NY: Routledge Press. <https://doi.org/10.4324/9781003331384-24>.
- Santomauro, Damian F., Ana M. Mantilla Herrera, Jamileh Shadid, Peng Zheng, Charlie Ashbaugh, David M. Pigott, Cristiana Abbafati, et al. 2021. "Global Prevalence and Burden of Depressive and Anxiety Disorders in 204 Countries and Territories in 2020 Due to the COVID-19 Pandemic." *The Lancet* 398 (10312): 1700–1712. [https://doi.org/10.1016/S0140-6736\(21\)02143-7](https://doi.org/10.1016/S0140-6736(21)02143-7).
- Šarčević, Ana, Damir Pintar, Mihaela Vranić, and Ante Gojsalić. 2021. "Modeling In-Match Sports Dynamics Using the Evolving Probability Method." *Applied Sciences* 11 (10): 4429. <https://doi.org/10.3390/app11104429>.
- Schöley, Jonas, José Manuel Aburto, Ilya Kashnitsky, Maxi S. Kniffka, Luyin Zhang, Hannaliis Jaadla, Jennifer B. Dowd, and Ridhi Kashyap. 2022. "Life Expectancy Changes since COVID-19." *Nature Human Behaviour* 6 (12): 1649–59. <https://doi.org/10.1038/s41562-022-01450-3>.
- Schultz, Lisen, Carl Folke, Henrik Österblom, and Per Olsson. 2015. "Adaptive Governance, Ecosystem Management, and Natural Capital." *Proceedings of the National Academy of Sciences* 112 (24): 7369–74. <https://doi.org/10.1073/pnas.1406493112>.
- Sharrow, David, Lucia Hug, Yang Liu, Naomi Lindt, and Danzhen You. 2023. *Levels & Trends in Child Mortality*. New York, NY: UNICEF.
- Sifat, Imtiaz Mohammad, and Azhar Mohamad. 2019. "Circuit Breakers as Market Stability Levers: A Survey of Research, Praxis, and Challenges." *International Journal of Finance & Economics* 24 (3): 1130–69. <https://doi.org/10.1002/ijfe.1709>.
- Smith, Adam. 1776. *An Inquiry into the Nature and Causes of the Wealth of Nations*. Strahan. <https://doi.org/10.1093/oseo/instance.00043218>.
- Statista. 2023. "Market Share of Leading U.S. Banks by Assets 2022." Statista.
- Tainter, Joseph A. 1988. *The Collapse of Complex Societies*. First edition. Cambridge: Cambridge University Press.
- . 1995. "Sustainability of Complex Societies." *Futures, Special Edition on "Anthropological Perspectives on the Future of Culture and Society,"* 27 (4): 397–407. [https://doi.org/10.1016/0016-3287\(95\)00016-P](https://doi.org/10.1016/0016-3287(95)00016-P).
- . 2014. "Collapse and Sustainability: Rome, the Maya, and the Modern World." *Archaeological Papers of the American Anthropological Association* 24 (1): 201–14. <https://doi.org/10.1111/apaa.12038>.
- Taleb, Nasim Nicholas. 2009. "Ten Principles for a Black Swan-Proof World." *Financial Times*, April 7, 2009, sec. Opinion.
- Taylor, Shelley E., and Jonathan D. Brown. 1988. "Illusion and Well-Being: A Social Psychological Perspective on Mental Health." *Psychological Bulletin*, March. <https://doi.org/10.1037//0033-2909.103.2.193>.
- Thompson, Suzanne C. 1999. "Illusions of Control: How We Overestimate Our Personal Influence." *Current Directions in Psychological Science* 8 (6): 187–90. <https://doi.org/10.1111/1467-8721.00044>.
- Thompson, Suzanne C., Alexandria Sobolew-Shubin, Michael E. Galbraith, Lenore Schwankovsky, and Dana Cruzen. 1993. "Maintaining Perceptions of Control: Finding Perceived Control in Low-Control Circumstances." *Journal of Personality and Social Psychology* 64: 293–304. <https://doi.org/10.1037/0022-3514.64.2.293>.
- Tullett, Alexa M., Aaron C. Kay, and Michael Inzlicht. 2015. "Randomness Increases Self-Reported Anxiety and Neurophysiological Correlates of Performance Monitoring." *Social Cognitive and Affective Neuroscience* 10 (5): 628–35. <https://doi.org/10.1093/scan/nsu097>.
- Vermeulen, Walter J. V. 2015. "Self-Governance for Sustainable Global Supply Chains: Can It Deliver the Impacts Needed?" *Business Strategy and the Environment* 24 (2): 73–85. <https://doi.org/10.1002/bse.1804>.
- Walker, Brian, and David Salt. 2012. *Resilience Practice: Building Capacity to Absorb Disturbance and Maintain Function*. First edition. Washington: Island Press. <https://doi.org/10.5822/978-1-61091-231-0>.
- Wang, Zhe, Tianzhen Hong, and Han Li. 2021. "Informing the Planning of Rotating Power Outages in Heat Waves through Data Analytics of Connected Smart Thermostats for Residential Buildings." *Environmental Research Letters* 16 (7): 074003. <https://doi.org/10.1088/1748-9326/ac092f>.
- WEF. 2023. "The Global Risks Report 2023." Geneva, Switzerland: World Economic Forum.
- WHO. 2022a. "World Mental Health Report: Transforming Mental Health for All. Executive Summary." Geneva, Switzerland: World Health Organization.
- . 2022b. "Mental Disorders." June 8, 2022.
- World Bank. 2022. "Literacy Rate, Adult Total (% of People Ages 15 and Above)." UNESCO Institute for Statistics.
- World Economic Forum. 2018. "Depression Is the No. 1 Cause of Ill Health and Disability Worldwide." World Economic Forum.
- . 2022. "This Is How Much Global Literacy Has Changed over 200 Years."
- Yang, Xiaokai, and Jeffrey D. Sachs. 2003. *Economic Development and the Division of Labor*. John Wiley & Sons. <https://doi.org/10.1002/9780470752036>.
- Zereyesus, Yacob Abrehe, Lila Cardell, Constanza Valdes, Kayode Ajewole, Wendy Zeng, Jayson Beckman, Maros Ivanic, Reem N. Hashad, Jeremy Jelliffe, and Jennifer Kee. 2022. "International Food Security Assessment, 2022–32." USDA Economic Research Service.