Washington Journal of Environmental Law & Policy

Volume 7 | Issue 2

7-1-2017

Introductory Essay: Catastrophe Thinking, Fast and Slow

Todd A. Wildermuth
University of Washington School of Law

INTRODUCTORY ESSAY:

CATASTROPHE THINKING, FAST AND SLOW

Todd A. Wildermuth*

Take the moment the trembling starts. Where do you go? Where does your mind go?

There are the things you know you should do with your body: drop to the ground, take cover, hold on, stay where you are.

There are the things you know you should do with your thoughts: Where is your family? Are they doing the same? Are they safe? Can you get to them?

In the rush of those thoughts come the surprising ones, the kinds of ideas that appear in a moment of forced clarity. These are not the questions that come naturally or in the course of normal days; a certain separation of the body and the mind is required. They come only with certain trembling of the spirit, with a rupture in all that seems usual. And they are rooted in, of all things, wonder.

Wonder over how life came to be at all; that something came from nothing can only be a wonder. How did that happen, anyway? Somewhere, some time, somehow: a sun, a planet just the right distance from it, billions of years, elements that became compounds that became life that became us. Us, with our eyes and hands and skin and bones that serve so well in so many moments but seem, in this one, somehow not quite built right. "Thy life's a miracle," and no less amazingly than now. That you may not "[s]peak yet again" cannot take away that you have spoken at all—indeed that human speech exists at all.[1]

---

* Todd A. Wildermuth, Director, Environmental Law Program, University of Washington School of Law.

1. WILLIAM SHAKESPEARE, KING LEAR act 4, sc. 6 (Jay L. Halio ed., Cambridge Univ. Press 2005) ("Thy life's a miracle. Speak yet again."). For an extended treatment and contemplation, *see* WENDELL BERRY, LIFE IS A MIRACLE: AN ESSAY AGAINST MODERN SUPERSTITION (2001).

Wonder over your survival beyond childhood. So many close calls, long forgotten, come now easily to mind. You have been here before—not exactly but close enough. The rise in adrenaline recalls those long-ago moments: fear unforeseen, fear realized, fear overcome. All packed away in your chest of life experiences and kept, somewhere inside, as a store called upon—consciously or not—to keep the thing that is you going. That humans spend so many years as vulnerable, inexperienced children seems now both precious and foolish. Why such slow progress through years that could be used living rather than learning to live? Why such a long apprenticeship in life? And given those years of chance and experiment and foolish youth, how does anyone make it through?

Wonder that our kind has separated so much from the other kinds that came up with us. How did one line become a heron, another a salmon, and ours a human? Time, chance, and more time, surely enough; it is a rational and utterly believable explanation, yet unsatisfying all the same. That branching is so hard to see, never mind that this trembling instant has slowed your sense of time to an infinity. Through how many unimaginably tedious accretions, through how many explosions of punctuated radiation, did strings of organic chemicals turn to wings, gills, scales, skins, fur, tails, forelegs, and fetlocks? Why some of those things to them, our traveling companions, and other things to us? The logic of the tortoise carapace or the chitinous shell suddenly takes on the character of genius. That humans bear no exoskeleton seems, momentarily at least, a serious design flaw.

And wonder that the special endowments of our kind—the opposable thumb, the upright stance, the large brain—have built such an unusual and novel second world of complex human creation. Without us there are no canvas packs, no cars, no computers, no cedar canoes, no carved gods; there are no swaying superhighways, vibrating highrises, crumbling asphalt, or caving bridges. All of that wonderful creation moving so steadily forward on all other days but this one. All of that wonderful creation: admirable for its complexity, for its own cleverness in coming together in space and time to serve our rich imaginations and bodily needs. Mighty one day, weak another; sturdy and knowable under normal circumstances, but fallible and mysterious right now.

As these wonders jumble together, drift apart, and join once

again, the moment of clarity becomes sharper as the usual world is becoming less recognizable.

You realize there is a difference between knowing, and knowing what to do.

***

We know far more about certain catastrophic risks than we have been willing to do anything serious about. This was not always the case, of course. There was a time when we could have plausibly said we had no real knowledge of a problem and therefore no possible obligation to do anything different. For climate change, the nuances of the date can be endlessly debated; the possible window puts Americans knowing somewhere between 1896, with transatlantic arrival of scientific findings from Sweden, and no later than James Hansen's testimony before Congress in 1988.[2] For the threats posed by a Cascadia fault megaquake, the range of possibility is smaller, with clear establishment somewhere in the early 1990s.[3] In either case, however, no fewer than two decades have passed since a core idea was established and no powerful contrary evidence has countered it. We have moved from ignorance, to knowledge of an existential threat, to inaction at any meaningful or suitable scale.

Tempting as it is to look backward and condemn inaction, the more necessary concern at present must be how to look forward and think urgently about rapid action. The complex world we have made on top of the prior world was built, we now see, on ignorant assumptions. We did not know then what we know now. Our concerns were not the concerns of the builders of the superhighways, or the coastal ports, or the downtowns, or the energy grids, or the communication networks; they could not have built or planned with knowledge we have but they did not. At all points in time, policy thinking and project planning are informed by the knowledge of that moment.

---

2. Philip Shabecoff, *Global Warming Has Begun, Expert Tells Senate*, N.Y. TIMES (June 24, 1988), http://www.nytimes.com/1988/06/24/us/global-warming-has-begun-expert-tells-senate.html?pagewanted=all.

3. SANDI DOUGHTON, FULL-RIP 9:0 THE NEXT EARTHQUAKE IN THE PACIFIC NORTHWEST 37 (Gary Luke ed. 2013) ("By the early 1990s, scientific skepticism [over the historic recurrence of Cascadia megaquakes] had vanished under the weight of the evidence . . . .").

It is not irrelevant who knew what when, or where they might have made better decisions; there may come a good day for that reckoning. But it is vastly more relevant, and more urgent, to decide what we should do now. A less important question is why those people back then did not act on the knowledge they had in their time. The more important question is why we today, with better knowledge, are failing to act on what we know.

***

Making analogies from individual behavior to societal behavior is fraught with danger. The two spheres, individual and collective, are not the same; an attempt to treat them on the same terms must always confront its own fiction. Still, some fictions can be useful fictions so I will briefly attempt to maintain one here: an argument that we can use a body of psychological science *as if* it applied to society at large. In doing so, I believe, we might better think about planning for, setting policy for, and enacting legislation for coping with the catastrophic threats of both climate change and megaquakes.

***

Daniel Kahneman has spent his professional life, much of it in partnership Amos Tversky, studying certain foibles of human decision-making—the internal patterns of thought that lead to beliefs, which in turn inform decisions, which shape actions, which humans use to remake the world.[4] Kahneman collected much of his life's work into a 2011 book, *Thinking, Fast and Slow*.[5] Borrowing from his own research and the research of others, Kahneman creates the central metaphor of his book by drawing a distinction between two "systems" of human thought: System 1 and System 2.[6]

The two systems work in tandem but have different modes and play different roles. System 1 "operates automatically and quickly, with little or no effort and no sense of voluntary

4. On the extraordinary intellectual partnership of Kahneman and Tversky, *see* MICHAEL LEWIS, THE UNDOING PROJECT: A FRIENDSHIP THAT CHANGED OUR MINDS (2016).

5. DANIEL KAHNEMAN, THINKING, FAST AND SLOW (2011).

6. *Id.* at 29 ("System 1 and System 2 are so central to the story I tell in this book that I must make it absolutely clear that they are fictitious characters.").

control."[7] System 2, in contrast, "allocates attention to the effortful mental activities that demand it, including complex computations."[8] We can think of these two systems alternatively as an "automatic" one (System 1) and an "effortful" one (System 2).[9] We go about our days regularly cycling back and forth between these two systems, cruising in a low-effort mode for most things and then pausing occasionally to work a bit harder concentrating on a difficult task.

Kahneman gives each system its due, and a rightful sphere of excellence: "The automatic operations of System 1 generate surprisingly complex patterns of ideas, but only the slower System 2 can construct thoughts in an orderly series of steps."[10] He credits System 2 with a special kind of human privilege, noting that the "operations of System 2 are often associated with the subjective experience of agency, choice, and concentration"[11]—in other words, with the things that humans use to consider ourselves as free-willed, sentient, purposeful actors in the world.

But do not become overly enamored of System 2, Kahneman warns. He cautions that System 2 is more akin to "a supporting character who believes herself to be the hero" than the true lead actor: "the thoughts and actions that System 2 believes it has chosen are often guided by the figure at the center of the story, System 1."[12]

How do the two systems trade off? Kahneman summarizes: "[M]ost of what you (your System 2) think and do originates in your System 1, but System 2 takes over when things get difficult, and it normally has the last word."[13]

But why, we might ask, all the bother with two systems at all? Why did they not just combine over time into, for example, a sort of moderate-effort SuperSystem 1 that manages everything? Kahneman credits the tandem system with, among other things, great energy management for the human

7. *Id.* at 20.
8. *Id.* at 21.
9. *Id.* at 29.
10. *Id.* at 21.
11. *Id.*
12. *Id.* at 31.
13. *Id.* at 25.

mind: "[t]he division of labor between System 1 and System 2 is highly efficient: it minimizes effort and optimizes performance."[14]

System 1 can run routine matters on low-energy autopilot to navigate the usual courses most of the time.[15] System 2 kicks in when there is unusual turbulence, when a gate-change is required, or when one's daily flight needs to be rerouted to an alternative destination; all of which requires careful, critical effort and higher energy.[16]

Much of the time, the autopilot-like function works right, or close to right enough: "System 1 is generally very good at what it does: its models of familiar situations are accurate, its short-term predictions are usually accurate as well, and its initial reactions to challenges are swift and generally appropriate."[17]

Alas, System 1 has its flaws. System 1 leads us to any number of biases, which Kahneman and others have described and are by now well known in many details.[18] Worse yet, System 1 occasionally tricks System 2 into remaining (inappropriately) dormant and drags the whole operation down. "Biases cannot always be avoided," Kahneman writes, "because System 2 may have no clue to the error."[19] Not least, "there are vital tasks that only System 2 can perform because they require effort and acts of self-control in which the [incorrect] intuitions and impulses of System 1 are overcome."[20] System 1, often so reliable, can fail—and its worst failures are those that fail to cue System 2 even to the possibility of error.[21]

Which might seem like a case for spending more time with one's System 2. Yet this, too, has its downsides.

Certain errors, Kahneman admits, "can be prevented only by the enhanced monitoring and effortful activity of System 2."[22] One could conceivably keep System 2 on a state of constant

14. *Id.*

15. *Id.* at 20.

16. *Id.* at 21.

17. *Id.* at 25.

18. *Id.*; *see, e.g.*, Cass R. Sunstein, Essay, *Empirically Informed Regulation*, 78 U. CHI. L. REV. 1349 (2011) (exploring the impact of our biases on regulatory policy).

19. KAHNEMAN, *supra* note **5**, at 28.

20. *Id.* at 31.

21. *Id.* at 28.

22. *Id.*

high alert in order to keep System 1 from mistakes. For a short duration, in situations of grave danger, an all-System-2 all-the-time kind of approach might be appropriate. Beyond a short duration, however, trouble follows. "As a way to live your life… continuous vigilance is not necessarily good, and it is certainly impractical."[23]

And it is here that Kahneman's research on individuals leads to solid advice-by-analogy to our society at large when we are faced with tough policy challenges such as climate change and megaquakes:

> Constantly questioning our own thinking would be impossibly tedious, and System 2 is much too slow and inefficient to serve as a substitute for System 1 in making routine decisions. *The best we can do is a compromise: learn to recognize situations in which mistakes are likely and try harder to avoid significant mistakes when the stakes are high.*[24]

We cannot remain on high alert at all times. Minds tire from the constant effort; their function diminishes. We can, however, force ourselves, collectively and selectively, to expend the extra mental effort when the danger of inattention is great—as, of course, it is in the instances of climate change and megaquakes.

A few other small pieces of Kahneman's research can help complete the usefulness of this proposed analogy.

When System 1 is challenged by a particularly tough problem, "the machinery of intuitive thought does the best it can."[25] Which is to say, as Kahneman and others describe it, the mind frequently appeals to "heuristics," a kind of System 1 shortcut, or shotgun approach, to finding an idea that seems applicable to the challenging circumstances.[26] Heuristics have the usual advantages of System 1: speed, energy efficiency, and a close-enough quality that renders them mostly useful to the individual most of the time—or at least not frequently harmful. When System 1 activates a heuristic, System 2 is bypassed or otherwise not engaged.

Unfortunately, a heuristic is an "alternative to careful

23. *Id.*

24. *Id.* (emphasis added).

25. *Id.* at 12.

26. *Id.* at 98.

reasoning"; it is not actual reasoning itself.[27] Challenge or novelty calls, one would think, for *more* active use of System 2. Yet System 2 is, for all its power (or perhaps precisely because of it), often reluctant to draw on our limited stores of mental energy. Kahneman calls it "lazy."[28]

System 2 always technically has the opportunity to detect, review, and reject intuitive answers (heuristics), but it often does not:

> [A] lazy system 2 often follows the path of least effort and endorses a heuristic answer without much scrutiny of whether it is truly appropriate. You will not be stumped, you will not have to work very hard, and you may not even notice that you did not answer the question you were asked. Furthermore, you may not realize that the target question was difficult, because an intuitive answer to it came readily to mind . . . .[29]

Kahneman calls this latter process, quite logically, the "substitution" of an easier question for a harder one.[30] We do it all the time—indeed, substitution captures the "essence of intuitive heuristics: when faced with a difficult question, we often answer an easier one instead, usually without noticing the substitution."[31]

***

Turn back to our concerns with catastrophe. Where, we might ask, have we committed collective System 1 errors? Where have we applied shotgun heuristics when careful reasoning would be required? When have we substituted an answer to an easier question for a harder-to-reach answer to a much tougher question?

We have done these things time and again. We have, culturally and politically speaking, applied System 1 responses to System 2 questions. As a result, when we do pause long enough to look at data, when we are able to free ourselves from the conventional wisdom, when we dig in a bit, we find our

27. *Id.*

28. *Id.* at 46 ("'Lazy' is a harsh judgment . . . but it does not seem to be [from the evidence] unfair.").

29. *Id.* at 99.

30. *See id.* at 97–105.

31. *Id.* at 12.

System 2 selves staring squarely at inadequate System 1 responses to important problems.

Climate change has been widely acknowledged as a "super wicked problem," one fraught with, among other things, global politics, split incentives, and the momentum of high investments in public and private infrastructure.[32] It poses, in Kahneman's theory, the kind of challenges that System 1 is notoriously bad at.[33]

Not only does climate change require stretching one's mind over the planet and imagining tons of invisible, odorless gas (CO_2). It also demands some ability to grasp statistical concepts—such as the difference between climate and weather, or between a given pattern of summer heat compared with patterns of summer heat that preceded it, or the likelihood that any given series of temperatures or rainfalls clustered simply by chance. System 1 is poor at statistics because statistics "requires thinking about many things at once, which is something that System 1 is not designed to do."[34]

Climate change does not establish clear certainties: it changes the odds of various outcomes over time and over the entire planet. Our understanding of climate change deals in possible alternatives made more likely, not definite outcomes made more certain.[35] Our individual System-1-led minds struggle with the lack of direct cause associated with a certain effect. We struggle with the absence of firm narrative coherence, which our minds crave. Our climate policies and planning seem to suffer for it.

---

32. Richard J. Lazarus, *Super Wicked Problems and Climate Change: Restraining the Present to Liberate the Future*, 94 CORNELL L. REV. 1153, 1153 (2009).

33. *See id*. at 1173–78 (highlighting problems that require long-term, thoughtful responses).

34. KAHNEMAN, *supra* note **5**, at 13.

35. The most recent Intergovernmental Panel on Climate Change (IPCC) reports show that predictions about future conditions are qualified twice—first with a statement about statistical likelihood and second with a statement about confidence. INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, CLIMATE CHANGE 2014: SYNTHESIS REPORT 10 (2014), https://www.ipcc.ch/pdf/assessment-report/ar5/syr/SYR_AR5_FINAL_full_wcover.pdf ("The global mean surface temperature change for the period 2016–2035 relative to 1986–2005 … will *likely* be in the range 0.3°C to 0.7°C (*medium confidence*)."). *See also* INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE, GUIDANCE NOTE FOR LEAD AUTHORITES OF THE IPCC FIFTH ASSESSMENT REPORT ON CONSISTENT TREATMENT OF UNCERTAINTIES (2010), https://www.ipcc.ch/pdf/supporting-material/uncertainty-guidance-note.pdf (discussing the IPCC's treatment of probabilistic predictions).

Pacific coast megaquakes operate similarly on our minds. Though perhaps not quite super wicked, they are mentally tough all the same: they deal with ranges of possibility, the consideration of multiple alternatives, and pure seismic stochasticity. Taking only the Cascadia fault, we cannot know where the subduction plate will release (the epicenter), how much energy it will release, what date and time it will quake, for how long any given location will shake, and what secondary shocks will be induced.[36] The energy that would carry outward from the subduction zone would act on a built environment that is in a constant state of tinkering and reconstruction. Absent anything close to complete or sufficient knowledge, we can only work in ranges of possibilities and approximations. To the extent our preparations and policies can have any reasoned basis, that basis must be at root statistical, perhaps combined with brute-force computational simulation.

For those who have slowed down in a System 2 way to engage climate change and megaquakes alike, there must be a persistent sense of banging one's head against a very hard and unyielding wall. Both cases threaten very real, potential catastrophes—events likely over many years but impossible to pinpoint to any given moment or place. Addressing such catastrophes squarely has required, does require, and will further require a kind of sustained System 2 "continuous vigilance" that Kahneman says is so hard for an individual to maintain—the state of intense attention he has called not "a good way to live your life."[37] What is our alternative, though?

***

36. In the absence of our ability to predict earthquakes, scientists and emergency managers have focused on the creation of early warning systems that activate and communicate the moment an active earthquake begins—i.e., that provide warning by a fast, electronic signal to human ears and communication devices before the somewhat slower incoming wave of the earthquake's released energy arrives. Such systems aim to provide "seconds to minutes" of warning using today's technology. *See, e.g.*, ERIN R. BURKETT ET AL., U.S. GEOLOGICAL SURVEY, USGS FACT SHEET NO. 2014-3083, SHAKEALERT—AN EARTHQUAKE EARLY WARNING SYSTEM FOR THE UNITED STATES WEST COAST 4 (Feb. 2017), https://pubs.er.usgs.gov/publication/fs20143083. The early warning system for the UW West Coast is called ShakeAlert; a version 1.2 prototype of the system was rolled out to limited public and private partners on April 10, 2017. *"ShakeAlert" Earthquake Early Warning System Goes West Coast Wide*, UNITED STATES GEOLOGICAL SURVEY (Apr. 6, 2017), https://www.usgs.gov/news/shakealert-earthquake-early-warning-system-goes-west-coast-wide.

37. KAHNEMAN, *supra* note **5**, at 28.

Fortunately, the analogy between policy thinking and individual thinking is only an analogy. No one human being, thankfully, needs to maintain the state of constant vigilance. No one human being could be watchful enough for us all, or sustain System 2 performance long enough. Even if possible, it would not be sufficient. Policy requires collective action and collective actors.

For a number of reasons, we can be confident that we are capable of a sustained, effective, and collective System 2 effort.

First, System 2 thinking may be hard for individuals to sustain in daily matters, but it is manageable for groups of individuals organized around institutions and shared aims. We build institutions, public and private, to outlive the individuals within them; institutional purpose is longer and greater than the institution's temporary operators. When we cannot sustain an effort on our own, yet know that effort to be necessary or useful—the manufacture of goods, the delivery of products, the care of the infirm—we develop institutions. We have not, in our policy and law-making, given enough effortful System 2 thought to catastrophe, but we know that we have the collective capacity for the effort.

Second, it is tempting to say that even a hard problem can have a simple solution. Entire societies of ants have conquered the earth with a relatively limited sense of a few social codes.[38] At the human scale, from a fairly small set of policy responses, the underlying drivers of climate change can be altered, redirected, and potentially reversed.[39] Indeed, a good case has been made that second or third-best climate solutions can pave the way to first-best ones; a society need not discern or achieve the best response on the first try to set an ultimately corrective course.[40] System 1 thinking—proximate heuristics or close-enough policies—are not *entirely* hopeless when writ large. Certain policy approaches might just be right enough frequently enough to permit a flurry of activity and then an increasingly lazy use of our collective System 2.

Third, the image of consistent, persistent, effortful System 2

38. *See generally* BERT HÖLLDOBLER & EDWARD O. WILSON, THE SUPERORGANISM: THE BEAUTY, ELEGANCE, AND STRANGENESS OF INSECT SOCIETIES (2008) (social organization of ants).

39. Jonas Meckling et al., *Winning Coalitions for Climate Policy*, 349 SCIENCE 1170, 1170 (2015).

40. *Id.*

analysis can suggest a distracting, and thankfully faulty, image: that our corrective actions must be carried out chiefly by government agencies or expert technocrats. Surely expert analysis is needed. Climate models and seismic hazard scenarios require sustained expertise, with highly educated scientists and significant funding to support their research. To make effective policy from that expertise, lawmakers and others will need to take seriously the need for System-1-challenging statistical projection. However, we can use an effortful, statistical mode of thinking to understand and analyze a threat, and then move on to pursue policy by any number of methods.

Given the shared stakes—again, catastrophe is not some remote possibility but a demonstrable threat—a society will rightfully seek some kind of firm, coercive response, i.e., some infringements on individual liberty for the tradeoff of greater individual security. This, of course, invokes law, duly debated and executed. Law has many guises: regulation, yes, but also government support for education and outreach, for insurance subsidy, for creating the rules that lead to new market formation. Where a culture of individual preparation exists, governments can reduce its efforts in that area; where a robust private insurance market exists, governments need not meddle. A collective System 2 approach to large-scale catastrophe planning seems as legitimate a purpose of government as there can be, i.e. a way to organize effort to collective benefit when individuals could not achieve the same aim acting on their own. Still, government need not actively control or dictate the exact terms of all, or even most, resilience preparation.

Lastly, the project ahead should be to continually engage a collective System 2 to assess catastrophic potential, normalize the critical discoveries through education, and then move the policy action back to the collective System 1. In individual lives, many things that were once effortful and required activation of System 2 became over time normalized; once adopted, System 1 begins to carry them out as part of a new normal, as a less effortful exercise of learned expertise. We might treat the formation of catastrophe policy as akin to getting through a rough path of turbulence by actively seeking a new altitude and then returning to autopilot. One need not, in carrying out daily activities that are shaped by policy, be vigilant about—or even particularly aware of—the System 2

thinking that informed the policy formation. We only need to have reliable confidence that, while cruising through our lives largely in our individual System 1s, that the collective System 2 has been invoked on our behalf.

That way, when the shaking—metaphorical or otherwise—starts and our wondering begins, we can wonder with more hope than fear, more uninvited amazement than uninvited terror. At that first tremor, maybe we will be able to find a modest comfort: that we have taken measures; that they were informed by the best of our deliberate, collective efforts; and that the world we have made might just accommodate the buckle and sway coming upon us.