WHARTON RISK CENTER PRIMER

ROLE OF HEURISTICS AND BIASES IN DECISION-MAKING FOR LOW PROBABILITY EVENTS

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DECEMBER 2020

We are in a new era of catastrophes with the number of low-probability, high-consequence (LP-HC) events increasing significantly. Due to a set of heuristics and cognitive biases, those residing in hazard-prone areas and decision-makers in the public and private sectors are underpreparing for disasters that are now occurring with more frequency and intensity.

This primer characterizes the nature of these heuristics and biases and why individuals often underprepare for LP-HC events. It then recommends using a new tool—the behavioral risk audit—that helps individuals, firms, and policy makers anticipate preparedness errors before they occur. The underlying principle of the audit is that the key to better preparedness lies not just in being able to better forecast hazards before they occur, but also forecasting how people will respond to the threat of these hazards —a response that is often suboptimal.

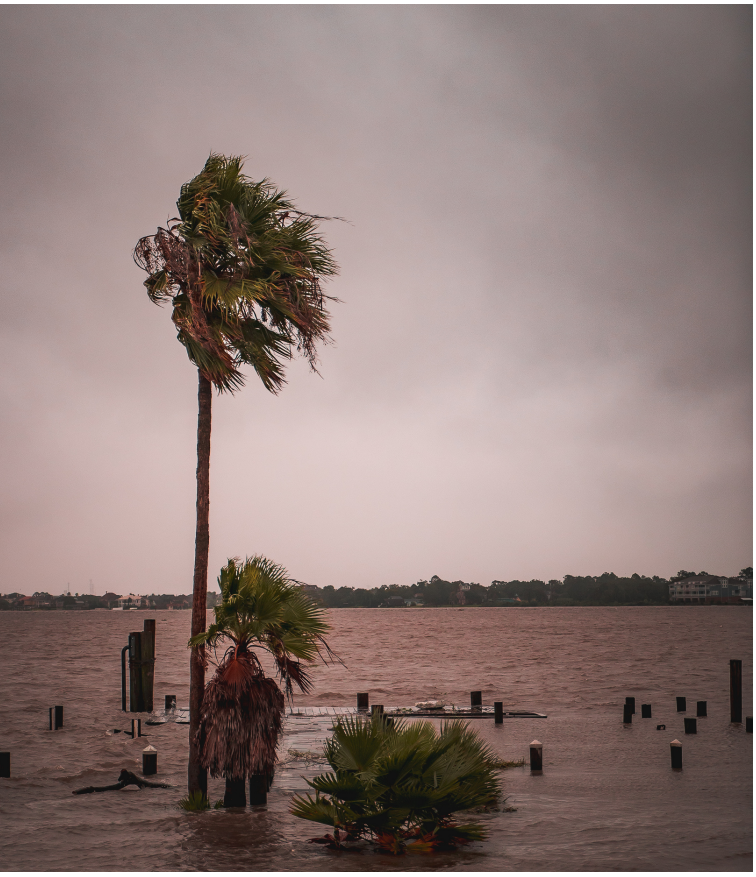
The Wharton Risk Management and Decision Processes Center, established in 1985, is a research center affiliated with the Wharton School at the University of Pennsylvania. The Center is recognized worldwide as a leader in risk-related research and policy analysis and serves as a bridge between scholars at Penn and organizations and decision-makers in the public and private sectors. Our primer series provides an introduction to topics in risk and resilience.

IMPORTANCE OF HEURISTICS IN DECISION-MAKING

In the 1950s, Herbert Simon coined the term bounded rationality, observing that we rarely make decisions optimally. He noted that because of our cognitive limitations, we utilize heuristics or rules-of-thumb that are adequate for solving most of the decisions that we face daily, but that are far from optimal in other circumstances. This idea was pursued in experiments by Daniel Kahneman and Amos Tversky in the 1970s, who suggested that these heuristics can be described and categorized.

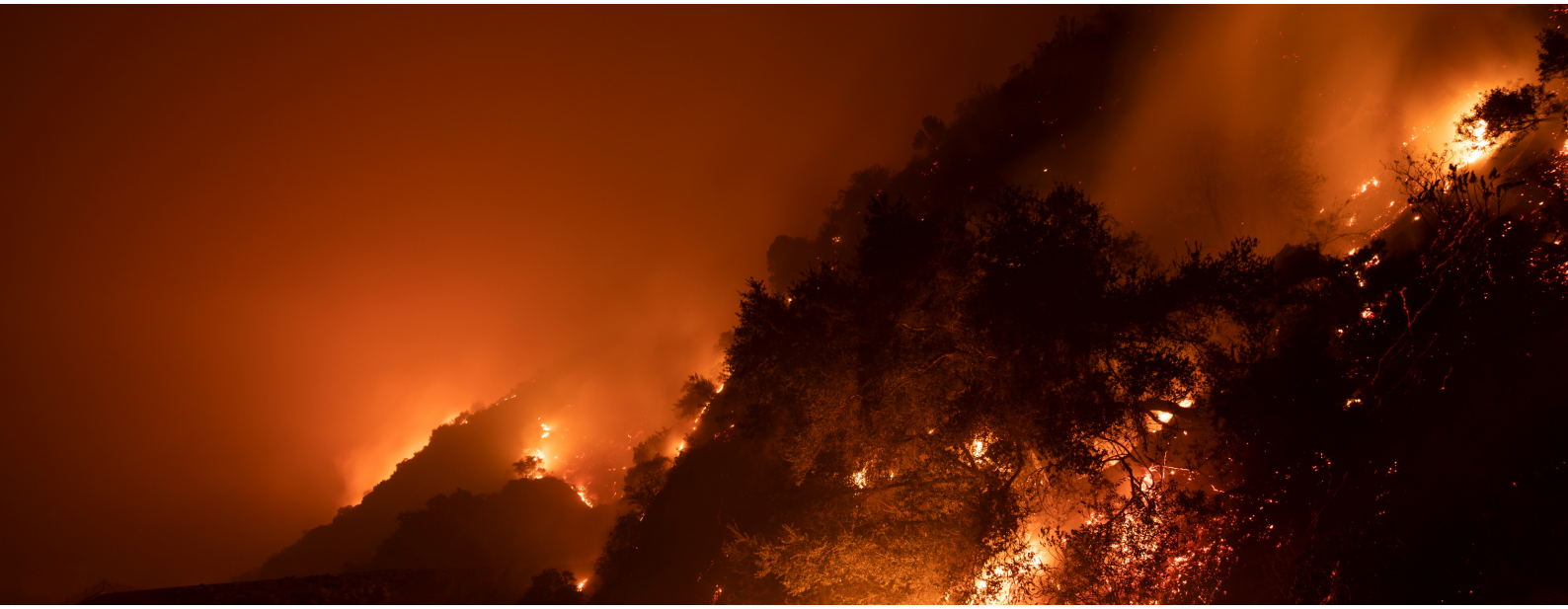
For example, Kahneman and Tversky discovered that judgments on the likelihood that an outcome will occur tend to be influenced by one or both of two heuristics:

- Availability: the ease in which similar instances of the event can be brought to mind. For example, intuitive estimates of the risk of an airline crash are governed by how easily one recalls news of crashes.
- Representativeness: the degree to which an event is stereotypically associated with a category. For example, a person may underestimate the risk of flooding from a hurricane if they think of hurricanes as primarily wind events.



Over the past 50 years, a large number of controlled experiments and field studies in psychology and behavioral economics have further developed these ideas, with a particular focus on how individuals react under conditions of risk and uncertainty. Findings from many of these studies are summarized in Daniel Kahneman's book, *Thinking, Fast and Slow* (Kahneman, 2011) which highlights two modes of thinking. Intuitive thinking (System 1) operates automatically and quickly with little or no effort and no voluntary control—for example, reflexively jumping at the sight of a mouse, or feeling the urge to flee when smelling smoke in a room. In contrast, deliberative thinking (System 2) allocates attention to effortful and intentional mental activities where individuals undertake trade-offs. For example, after smelling smoke in a room, deciding how best to exit, or informing others as to what they should do.

It is important to note that neither intuitive nor deliberative thinking is inherently bad or good. While it may be tempting to suggest that we should encourage people to engage in deliberative rather than reflexive or intuitive thinking when preparing for disasters, this presumes the inputs to the deliberative decisions are accurate, and the trade-offs that will be made are the appropriate ones. As an example, if smoke begins to permeate a crowded room, one hopes that people will follow their instincts to flee, not pause to deliberate over the likely source of the smoke by attempting to determine the likelihood that the threat of a possible fire is real. Or, if a gunshot were heard in a school, students would follow well-established protocols rather than deliberating as to how they should respond. In contrast, intuitive thinking may lead to poor decisions if relevant information is ignored. For example, a coastal resident who has experienced multiple false alarms of a possible tsunami may be making a potentially fatal mistake by not carefully listening to warnings to evacuate the area before it is too late.



BIASES IMPACTING PREPARATION FOR LP-HC EVENTS

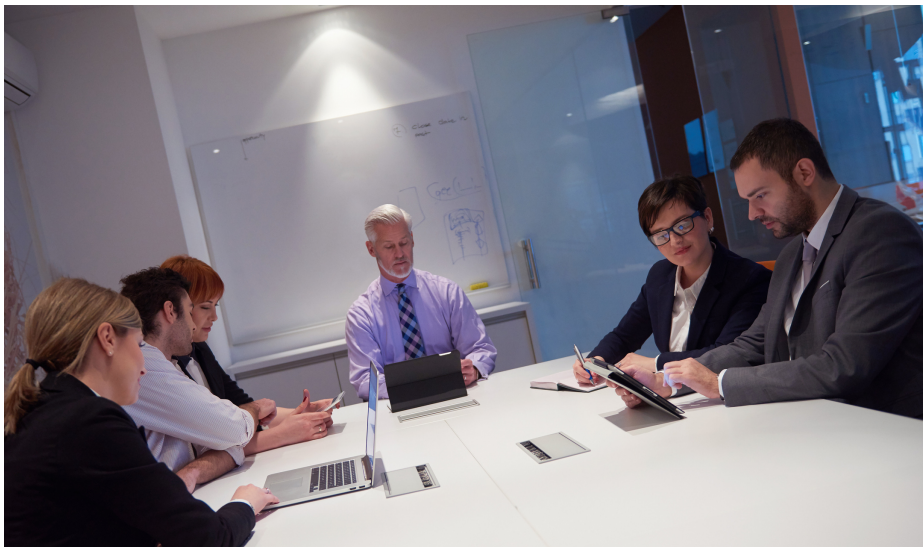
In *The Ostrich Paradox: Why We Underprepare for Disasters* (Meyer and Kunreuther, 2017), we built upon prior work on heuristics to develop a taxonomy of decision-making biases that often cause individuals, communities, organizations and institutions to underinvest in protection against low-probability, high-consequence events. We identified six major biases:

- Myopia: a tendency to focus on short future time horizons when appraising immediate costs and the potential benefits of protective investments
- Amnesia: a tendency to forget too quickly the lessons of past disasters
- Optimism: a tendency to underestimate the likelihood that losses will occur from future hazards
- Inertia: a tendency to maintain the status quo or adopt a default option when there is uncertainty about the potential benefits of investing in alternative protective measures
- Simplification: a tendency to selectively attend to only a subset of the relevant facts when making choices involving risk
- Herding: a tendency to base choices on the observed actions of others

Note that these biases potentially arise when engaging in both System 1 and System 2 thinking. For example, optimism can be seen as a System 2 bias if it takes the form of an underestimation of the likelihood of a disaster when making a deliberative cost-benefit assessment of how much to invest in protection. But it can also be seen as a System 1 bias if it causes decision makers to ignore the consequences of a disaster if they treat its probability as below their threshold level of concern.

ROLE OF A BEHAVIORAL RISK AUDIT FOR ADDRESSING BIASES AND HEURISTICS

A behavioral risk audit is an approach that recognizes biases that lead individuals to underprepare for future disasters. The essence of the approach is that, rather than trying to eliminate the biases noted above, individuals and policy makers should instead accept them as inherent constraints in decision-making, and develop policies that work with, rather than against, them. A behavioral risk audit involves the following five steps:



- Context specification: Identify a hazard that poses a risk to life or property, and the situational context of that threat. For example, a threat could be wildfires, and the context homeowners living in exposed communities;
- Bias manifestation: For each of the six decision biases above, identify how the bias would manifest in the context of this hazard. For example, optimism would be reflected in a homeowner's perception that their house would not suffer any damage from a future wildfire in an area subject to this hazard;
- Implication for under-preparedness: For each of these six biases, indicate how it could lead to a specific form of under-preparedness. For example, believing that one's home will not suffer damage from a wildfire would cause the homeowner to underestimate the value of investing in fire-proofing materials and designs;
- Identification of remedies: Address the problem of under-preparedness by developing potential remedies for each of the biases. To avoid optimism, one could develop graphic communication plans that increase the ease with which the impact of a future fire is conveyed, and provide financial incentives that make investments in loss reduction measures worthwhile even under optimistic assessments of the fire risk;
- Prioritization: After determining possible remedies for under-preparedness tied to each of the six biases, prioritize their implementation based on synergies between the remedies and available resources. For example, communication plans that increase the ease with which the risk of fire is brought to mind can be inexpensive and may address optimism, amnesia, and myopia.

Below is an example of how such a behavioral risk audit can address each of the six biases noted above to encourage homeowners to pay attention to their flood risk.

- Myopia: Provide homeowners with a long-term loan tied to their mortgage to spread the upfront cost of the flood reduction measure over a number of years. Then show them that the reduction in their annual flood insurance premium is greater than the yearly cost of the loan, thus giving them a net savings in year 1 and all future years.

- Amnesia: Keep the memory of past floods and hurricanes high on people's agenda via communication campaigns. Graphic photos or videos about past floods remind individuals of the negative emotions they experienced during these disasters.

- Optimism: Rather than stating that the chance of a severe hurricane next year is 1-in-100, stretch the time horizon to 25 years and indicate that there is a greater than 1-in-4 chance that there will be at least one such hurricane during this period.

- Inertia: Homeowners insurance is generally required as a condition for a mortgage. If flood insurance were included as a rider that one could opt out of, it is likely that many individuals would decide to keep this coverage due to the tendency to maintain the status quo. Individuals would also learn that water-related damage is not included in a standard homeowners insurance policy.

- Simplification: To overcome the tendency to focus only on the low likelihood of a hurricane and not think about its consequences, present a worst-case scenario of severe storm damage to encourage homeowners to pay attention to the consequences of the disaster. This may increase their interest in investing in loss reduction measures and to purchase flood insurance.

- Herding: It may be possible to create a social norm for protecting one's property, if homeowners who invested in loss reduction measures were given a seal of approval by a certified inspector and informed that their property values would likely be increased due to the reduced losses from future hurricanes. If a social norm does not occur, then it may be necessary for building codes to require homeowners to invest in cost-effective loss reduction measures.

DEVELOPING A RISK MANAGEMENT STRATEGY FOR LP-HC EVENTS

Addressing decision-making biases through a behavioral risk audit is part of a broader risk management strategy. Ideally, the interested parties concerned with reducing future disaster losses will utilize a number of the measures proposed here to convince property owners to consider taking action now so they avoid significant losses from the next disaster. A risk management strategy that is likely to be successfully implemented could involve the following stakeholders, each of whom would have a role to play:

- Scientific experts: provide data on the likelihood and consequences of future low-probability events in a transparent manner;
- Real estate agents: communicate information to current homeowners and prospective buyers so they recognize the importance of investing in protective measures to reduce damage from future disasters;
- Banks and lenders: offer home improvement loans to make property safer;
- Insurers: provide homeowners insurance policies that incorporate hazards such as floods and earthquake coverage with risk-based premiums and allow property owners to opt out of coverage;

- Communities: develop well enforced standards (e.g., building codes) and regulations (e.g., zoning restrictions) to make the community a safer and more attractive place in which to live;
- Public sector: assist low- and middle-income residents who cannot afford home improvement loans with mitigation grants to encourage them to invest in cost-effective measures to reduce their risks of losses;

Given the likely increase in LP-HC events in the coming years, it is important to recognize that some of the stakeholders above are also prone to exhibit biases. By providing accurate information on the risk coupled with economic incentives and well-enforced regulations and standards, there is a good chance of reducing the serious consequences of future black swan events.

References

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

Meyer, R., & Kunreuther, H. (2017). *The Ostrich Paradox: Why We Underprepare for Disasters.* Wharton Digital Press.