A Description–Experience Framework of the Dynamic Response to Risk

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Abstract

The modern world holds countless risks for humanity, both large-scale and intimately personal—from cyber warfare, pandemics, and climate change to sexually transmitted diseases and drug use and abuse. Many risks have prompted institutional, regulatory, and technological countermeasures, the success of which depends to some extent on how individuals learn about the risks. We distinguish between two powerful but imperfect teachers of risk. First, people may learn by consulting symbolic and descriptive material, such as warnings, statistics, and images. Yet more often than not, a risk's fluidity defies precise description. Second, people may learn about risks through personal experience. Responses to risk can differ systematically depending on whether people learn through one mode, both, or neither. One important reason for these differences is the discrepancy in the cognitive impact that rare events (typically the risk event) and common events (typically the non-occurrence of the risk event) have on the decision maker. We propose a description–experience framework that highlights the dynamic relationship of description and experience and the importance of the statistical structure of risk events and that offers a new perspective on humans' sometimes puzzling responses to risks.

Keywords: description–experience gap, information sampling, probability weighting, risk behavior, risk communication, risk perception

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In the shadow of North Korea's nuclear missiles, South Koreans routinely go about their daily business (Friedman, 2017). One key factor in their nonchalance may be their past experience: Between the first test in 1984 and March 2020, North Korea carried out 147 missile tests, conducted six nuclear test explosions, and repeatedly verbally abused its neighbor to the south (Arms Control Association, 2020). Having experienced over three decades of tests and bluster, most South Koreans seem to agree that a barking dog never really bites. Yet despite collectively shrugging at missile launches, South Koreans responded vigilantly to the COVID-19 threat when most other countries and their citizens were idling (Sang-Hun, 2020). This may also be due to their past experience: In 2015, South Korea was on the brink of a MERS pandemic. The countermeasures introduced to curb the virus reached extensively into people's daily lives (Seoul Metropolitan Government, 2015).

Experience matters. Yet it is not the only way of learning about risks. Another powerful teacher is description. In some circumstances, people have both modes to hand; in others, they have recourse to only one. For instance, physicians can consult health statistics to evaluate the risks of a medical intervention as well as recall their own experience of treating their patients and monitoring the effects. Patients, on the other hand, may initially have no experience with the intervention; they can only check descriptions (e.g., relevant statistics) to help them understand the risk they face. Furthermore, the lessons that description and experience convey do not necessarily converge; they sometimes contradict each other. We suggest that research into the description–experience dynamic and these two powerful but imperfect teachers will help provide a clearer picture of how people perceive and respond to risk.

The present description–experience view on human responses to risk complements existing frameworks of risk perception such as the psychometric approach (Slovic, 1987), social amplification of risk (Kasperson et al., 1988), and information framing (Peters, Hart, &

Fraenkel, 2011) by drawing attention to the dynamic process of learning about risks and to the statistical properties of risk events (see also Rogers, 1997). To shed light on learning and the sometimes collaborative, sometimes competitive dynamic of symbolic descriptions and personal experience, we turn to a longstanding line of research: risky choice between monetary gambles. Although our ultimate concern is with the psychological response to real-world risks, and not with choice in contrived experimental contexts, this line of research—in particular, its innovative investigation into the description–experience gap—has accumulated valuable evidence for predicting human response to risk.

The Description–Experience Perspective in Risky Choice

Using monetary gambles to examine how people respond to risk is a time-honored tradition (e.g., Bernoulli, 1738/1954). This fondness for gambles is understandable. Monetary gambles embody what many consider to be the building blocks of real-world choice options: an option's potential outcomes and the outcomes' respective probabilities (Lopes, 1983). These are the pillars of influential choice models such as expected value theory, expected utility theory, and cumulative prospect theory. When studying human choice between monetary gambles, most scholars have relied on gambles in which all information about the options' outcomes and their probabilities are explicitly stated or symbolically represented (e.g., pie charts). Consider the following gamble pair (from Kahneman & Tversky, 1979):

A:	50% chance to win 1,000 [shekels], 50% chance to win nothing.	**B:**	459 [shekels] for sure.

All possible information is stated, leaving people to make a *decision from description* (see Hertwig & Erev, 2009). Real-world decisions from description are sometimes possible: Weather forecasts, actuarial tables, and mutual-fund brochures all offer descriptions of possible outcomes and probabilities. Yet many human behaviors—falling in love, going on job interviews, crossing the street—come without a manual detailing the possible outcomes and their probabilities. There is another way to learn about risk, however: People can rely on their personal experiences, thereby making *decisions from experience* (Hertwig & Erev, 2009).

The Description–Experience Gap

Experimental research on decisions from experience has typically involved a simple experimental tool: a "computerized money machine" (Wulff & Hertwig, 2019; Wulff, Markant, Pleskac, & Hertwig, 2019) in which people usually face two buttons on a computer screen, each one representing an initially unknown payoff distribution. Each click of a button implements a random draw from one distribution (such as option A or B in the choice problem above). There are three variations of this money machine (see Hertwig & Erev, 2009): (1) people first sample as many outcomes as they wish until they decide from which distribution to make a single real draw, (2) each draw contributes to people's earnings and they receive draw-by-draw feedback on the obtained and forgone payoffs (i.e., the payoffs they would have received had they selected the other option), and (3) each draw contributes to people's earnings and they receive draw-by-draw feedback about obtained payoffs only. Choices that people make in these experimental paradigms are then compared to choices made from stated outcomes and probabilities.

As a substantial body of research has shown, decisions from description and decisions from experience can lead to systematically different choices. This is known as the *description–experience gap*. While there are different ways to define and illustrate this gap (see Rakow & Newell, 2010; Wulff, Mergenthaler-Canseco, & Hertwig, 2018), the results are surprisingly similar. One way is depicted in Figure 1. It shows systematic differences in choice proportions from experienced-based and description-based gambles across a large set of choices with different outcomes and probabilities. Choice proportions differ systematically as a function of the true probability of the rarest outcome in the choice problem. Meta-analytic results (Wulff et al., 2018) have shown that when a choice involves a risky and a safe option—the choice task often used to measure risk preference behaviorally (see Hertwig, Wulff, & Mata, 2019)—the gap amounts to 18.7 percentage points; when a choice involves two risky options, the gap is 7 percentage points. The gap is systematic: In decisions from description, people choose as if they give more weight to ("overweight") rare events than these events deserve in light of their objective probabilities. This pattern is consistent with the weighting of rare events as postulated by cumulative prospect theory (Tversky & Kahneman, 1992). In decisions from experience, people choose as if they give less weight to ("underweight") rare events than these events deserve in light of their objective probability. This pattern directly contradicts the one commonly assumed in prospect theory. Let us emphasize that the notion of weighting is meant in an as-if sense—that is, people choose as if rare events had more or less impact than they deserve. Furthermore, as-if weights refer to the objective probabilities of the outcome distributions and not to the relative frequencies with which people actually experienced the events (see also Regenwetter & Robinson, 2017); in the sampled experience, objective probabilities and experienced frequencies can differ.

This systematic gap in the implied impact of described and experienced rare events is likely to be relevant for risk perception and behavior beyond monetary gambles, as rarity is a key property of real-world risks (see also Martin, Gonzalez, Juvina, & Lebiere, 2014). Pandemics, serious side effects of vaccination, and car accidents are—fortunately—all rare events, even though the respective fatalities may follow different distributions (e.g., thin-tailed vs. fat-tailed; Cirillo & Taleb, 2020) and impact individuals or collectives. In order to examine the possible implications of the description–experience gap for how people respond to rare risks, we must first consider the scope of the gap.

The description–experience gap is not limited to risky choice. It has been observed in many reasoning and choice domains, including intertemporal choice (Dai, Pachur, Pleskac, & Hertwig, 2019), social interaction in strategic games (Isler, Kopsacheilis, & van Dolder, 2020; Martin et al., 2014), ambiguity aversion (Dutt, Arló-Costa, Helzner, & Gonzalez, 2014; Güney & Newell, 2015), consumer choice (Wulff, Hills, & Hertwig, 2015), financial risk taking (Lejarraga, Woike, & Hertwig, 2016), medical judgments and decisions (Armstrong & Spaniol, 2017; Fraenkel, Peters, Tyra, & Oelberg, 2016; Lejarraga, Pachur, Frey, & Hertwig, 2016; Wegier & Shaffer, 2017), adolescent risk taking (van den Bos & Hertwig, 2017), categorization (Nelson, McKenzie, Cottrell, & Sejnowski, 2010), and causal reasoning (Rehder & Waldmann, 2017). These findings suggest that the distinction between description and experience is relevant for cognition and behavior more generally, although not all gaps are necessarily characterized by over- and underweighting of rare events (see, e.g., Lejarraga, Woike, et al., 2016; van den Bos & Hertwig, 2017).

Before moving on to consider the four different epistemic states in which people may find themselves when making decisions involving risk, let us take a closer look at the defining characteristics of experience.

Attributes and Ambiguities of Experience

Experience is the process and result of living through events (see Hertwig et al., 2018; March, 2010). It can have physiological (e.g., pain or pleasure), cognitive (e.g., information) and subjective aspects (e.g., unpleasantness); sometimes it has predominately informational value and sometimes informational and material effects co-occur and conflict (i.e., the exploration–exploitation trade-off (Sutton & Barto, 1998). Experience can be used to evaluate past actions and guide future ones (March, 2010). Positive experience with an option increases the probability that this option will be chosen in the future; negative experience has the opposite effect (Denrell & March, 2001). Although undergoing an experience may require effort, learning from experience is often relatively effortless and immediately authoritative for the experiencing individual. Organisms automatically make inferences, abstractions, or generalizations based on their experiences. Sometimes gathering experience of the risk of harm is voluntary (e.g., going downhill skiing and possibly being injured); sometimes the environment imposes the potential experience of harm (e.g., suffering a heat wave and experiencing the health risks of record temperatures).

Although anchored in the reality of the individual, the interpretation of experience can be ambiguous for several reasons (March, 2010), such as noise due to errors in observation, truly stochastic structures in the world, and the importance of learning not only from actual events but also from those that could have, but did not, occur. Among the many open and interesting issues surrounding experience is the question of what should count as personal experience and, relatedly, to what extent vicarious experience has the attributes of personal experience. A vicarious experience is commonly understood as an empathetic state in response to the observation of others' sensations, emotions, and actions (Keysers & Gazzola, 2009). Vicarious experiences appear to recruit neural processes similar to those involved in the primary experience of a sensation, emotion, or action (e.g., Singer et al., 2004).

Another source of ambiguity is that experience typically represents a momentary sample. Just how representative this sample is for the risk event in question depends on many factors, including the risk event's statistical structure (e.g., Cirillo & Taleb, 2020), people's ability to take into account biases in the sampling process and the sample (e.g., Fiedler & Juslin, 2006; Hogarth, Lejarraga, & Soyer, 2015), the risk event's temporal dynamic (e.g., immediate or delayed consequences or gradual change in the risk), the extent to which people are disinterested observers or act in the pursuit of goals that may impact a risk's likelihood (Le Mens & Denrell, 2011), and the strength and detectability of an experiential signal (e.g., rising yearly temperature) relative to the noise of random fluctuation around a central trend (Weber & Stern, 2011). Descriptions are not devoid of ambiguities either; some are similar to those listed above and others are specific to descriptions (e.g., the trustworthiness of the description's author).

A Fourfold Pattern of Epistemic States and the Description–Experience Dynamic

In principle—and accepting the simplistic description–experience dichotomy (see Hertwig, Hogarth, & Lejarraga, 2018)—there are four epistemic states in which people can find themselves when faced with a decision involving risk. In this section, we outline these epistemic states and draw on empirical findings on the description–experience gap to suggest specific regularities in people's responses to risk in each. This exercise in extrapolation promises to yield interesting insights and to reveal research questions that would benefit from systematic investigation.

Consider the decision of whether to vaccinate a child against measles, mumps, and rubella (MMR). Both options—to vaccinate or not to vaccinate—carry potential benefits and harms. Leaving aside the fact that in numerous countries MMR vaccination is mandatory, parents and physicians can learn about the statistical probabilities of outcomes through description, experience, both, or neither. The result is a fourfold pattern of epistemic states (Figure 2).

Description Only: As-If Overweighting of Rare Events

The first epistemic state (Figure 2, upper left cell) could represent the knowledge state of a first-time parent who lacks personal experience with the probabilistic consequences of having a child vaccinated and therefore needs to consult descriptions of possible outcomes and their probabilities. But not all descriptions are the same. Let us assume that a parent is unwittingly directed—via algorithm recommender systems and through motivated reasoning—to vaccine-critical websites that focus on severe reactions to vaccination (see Betsch, Renkewitz, Betsch, & Ulshöfer, 2010) including the refuted link with autism (Taylor, Swerdfeger, & Eslick, 2014). For instance, 2–16 people out of 10,000 (p = .0002 to .0016) are reported to experience febrile seizures as a consequence of MMR vaccination (Harding Center for Risk Literacy, 2016). Generalizing the as-if probability weighting pattern introduced earlier, such rare risks will loom larger than they ought to in light of their objective probabilities. All other things being equal, this parent may therefore overweight the rare harm of the vaccine relative to its linear weighting, and be more inclined to decide against vaccinating their child. Alternatively, a parent may come across a Fact Box (Figure 2): a simple tabular summary of the best available evidence about the benefits and harms of a medical procedure, treatment, or health behavior (McDowell, Rebitschek, Gigerenzer, & Wegwarth, 2016). Such a Fact Box would also report another rare risk: that of dying from the measles virus. It is estimated that 9–28 out of every 10,000 people exposed to the measles virus who are not vaccinated die, relative to 0–2 of those who are vaccinated. Assuming the rare risk of death from the virus (without vaccination) and the rare risk of harm triggered by the vaccination are now both overweighted, and all other things being equal, the psychological impact of the latter will no longer be selectively amplified.

From a public health point of view, the overweighting of rare side effects in the first scenario is an undesirable outcome. However, overweighting rare events can also result in desirable policy outcomes. Consider the risk of secondhand smoke, which is estimated to have caused more than 7,300 lung cancer deaths in the US each year from 2005 to 2009 (Centers for Disease Control and Prevention, 2018). This is a relatively rare outcome given that approximately 58 million people in the US were exposed to secondhand smoke during 2013–2014 (Tsai et al., 2018). Explicit descriptions of the threat of secondhand smoke and its risks (e.g., lung cancer) may lead people to overweight these relatively rare risks. This, in turn, may make smokers, nonsmokers, and policymakers more likely to act—for instance, by endorsing restrictions on smoking areas.

Overweighting of rare events has been observed in the context of risky choices involving explicitly stated outcome and probability information. But not all descriptions contain information on probabilities. Consider a simple warning that secondhand smoke is detrimental to a person's health. According to support theory (Rottenstreich & Tversky, 1997), the *judged* probability (or frequency) of health risks of secondhand smoke will, all other things being equal, increase when this generic warning is unpacked into its components (sudden infant death syndrome, asthma attacks, lung cancer, heart disease, etc.; Centers for Disease Control and Prevention, 2019b). People would thus tend to overestimate the likelihood of each component risk relative to the probability of the inclusive event "health risks of secondhand smoke." As-if overweighting of stated small probabilities and overestimating of small probabilities of stated events (e.g., lung cancer due to secondhand smoke) can, in principle, collude to boost the psychological impact of a rare risk (see also Viscusi, 1990; Viscusi & Hakes, 2008; but also Slovic, 2000). When this amplified risk represents a harm, and all other things being equal, people will be more risk averse than they would otherwise be.

Experience Only: Varying Weighting Patterns of Rare Events

The second epistemic state (Figure 2, lower right cell) could represent the knowledge state of a physician who prefers to ignore statistics in favor of making decisions based on their experience of administering the MMR vaccine. Because the potential harms associated with the MMR vaccine are rare, this physician is unlikely to have ever seen patients with serious side effects. On average, a physician would have to administer 23,024 MMR shots (assuming a prevalence of 2 in 10,000) to experience a child having a vaccine-related seizure (Harding Center for Risk Literacy, 2016) with 99% probability.

As-if underweighting of rare events

Generalizing the common probability-weighting pattern from research on the description–experience gap to this epistemic state, one may expect this physician to behave as if they underweight rare (and possibly delayed; De La Maza, Davis, Gonzalez, & Azevedo, 2019) risks. Their experience tells them that rare events are indeed rare. Consequently, when this attenuated risk represents a harm, and all other things being equal, they will be less risk averse than they would otherwise be. This behavior may also contribute to phenomena such as post-surgery opioid overprescription (Thiels et al., 2017). Underweighting is most pronounced with very limited experience, since a rare event is particularly unlikely to arise in a small sample. But as-if underweighting of rare events can occur even with ample experience: for instance, when a physician's small sample of recent relevant experience has more sway than their ample past experience (e.g., because it is better remembered) or when a physician has ample experience but relies on only a few episodes (see Stewart, Chater, & Brown, 2006) when making a decision. Finally, a cognitive process according to which a person makes choices by focusing on similar clusters of experience also implies reliance on small samples (Plonsky, Teodorescu, & Erev, 2015).

The dynamics of experience: The hot-stove effect and experiential refractory periods

Although as-if underweighting of rare events in experience is a robust pattern (see Hertwig et al., 2019), in terms of their aggregate impact, experiential dynamics can create the opposite effect. The *hot-stove effect* refers to a behavior that initially yielded a very adverse outcome and can therefore give rise to a powerful bias that results in the organism refraining from revisiting this behavioral again (Denrell, 2005, 2007; Denrell & March, 2001). A cat that sits on a hot stove-lid may never approach another one, regardless of whether it is hot or cold (Twain, 1897, p. 124). The cat behaves as if it overweights the (possibly) rare event of getting singed. The likelihood of a hot-stove effect depends on a number of factors, such as whether the organism can take precautionary actions (e.g., turning off the stove), the causal model the organism employs (e.g., believing that lightning never strikes twice), and the kind of feedback (e.g., whether organisms receive feedback about what would have happened had they chosen the forgone action). Related to the hot-stove effect is the Depression-babies effect (Malmendier & Nagel, 2011)—the phenomenon that people who live through macroeconomic shocks (e.g., the Great Depression) subsequently take fewer financial risks. Experimental research has also demonstrated that extreme negative outcomes, once experienced, may have disproportionate sway on people's decisions (Ludvig, Madan, & Spetch, 2014; Lejarraga, Woike & Hertwig, 2016; Spitzer, Waschke, & Summerfield, 2017), making people more risk averse then they would otherwise be.

Importantly, experience-induced risk aversion can be transient, especially if the action in question is unavoidable (Le Mens & Denrell, 2011) or a person has the chance to observe outcomes for an option they did not choose. After an action has resulted in harm, a person is likely to be on alert and behave as if they overweight the risk, at least during what could be called an *experiential refractory period* (see also Plonsky et al.'s, 2015, notion of a wavy recency effect). The duration of this period likely depends on factors such as the magnitude of the experienced harm. For instance, the likelihood that a driver will break the speed limit drops significantly in the two months after experiencing a severe collision (O'Brien, Bible, Liu, & Simons-Morton, 2017), with psychological distress remaining elevated for up three years post-collision if they were injured (Craig et al., 2016). As the driver accumulates safe driving experiences, the psychological impact of the rare event on their behavior wanes, and they return to their pre-accident driving behavior.

Experience and Description: Does One Overrule the Other?

The third epistemic state (Figure 2, upper right cell) features both description and experience. This could be the epistemic state of a physician who has read the relevant MMR health statistics and also has a wealth of personal experience administering the vaccine, or of a person who is aware of statistics on the risk of sexually transmitted diseases (STDs) and has had unprotected sex. Do these two types of risk representation—description and personal experience—integrate, or does one drown out the other? It is commonly thought that descriptive warnings are often ignored and may even backfire (Andrews, 2011; Steinhart, Carmon, & Trope, 2013). Meta-analyses on the efficacy of warnings have highlighted factors that shape their success, such as intended behavioral outcome, audience characteristics, message content, and delivery modes (e.g., Argo & Main, 2004; Purmehdi, Legoux, Carrillat, & Senecal, 2017). While such analyses are important for designing more effective warnings, it is also important to consider the target audience's experiential starting point.

In the context of syphilis, for example, the proper use of condoms reduces the risk of contracting the disease. But a warning about the risks of unprotected sex may run counter to a person's experience of unprotected sex without negative repercussions. Indeed, in 2018, there were 10.8 cases of syphilis per 100,000 people in the US (Centers for Disease Control and

Prevention, 2019a). Assuming that someone needs to come into direct contact with a syphilis sore just once to become infected, they would need to have sex with 6,418 people to reach a 50% probability of contracting syphilis. Experience of safe encounters can potentially thwart a warning's ability to shape behavior. This dynamic may also help explain why early climate change warnings were relatively ineffective (Weber, 2006; Weber & Stern, 2011).

Several key factors determine the relative impact of description and experience. Timing is one: When a warning coincides with the start of a decision-making process, it receives more weight than when it follows safe experiences (Barron, Leider, & Stack, 2008). Warnings at the outset of a decision-making process can also induce safer behaviors in future decisions because the first instance is established as the default. Complexity is another factor: The impact of description on experience-based choice decreases when the tasks—and thus the task descriptions—become too complex (Weiss-Cohen, Konstantinidis, Speekenbrink, & Harvey, 2018; see also Lejarraga, 2010). Generally speaking, experience often seems to take precedence over description, which sometimes gets ignored altogether in decision making (Erev, Ert, Plonsky, Cohen, & Cohen, 2017; Lejarraga, 2010; Lejarraga & Gonzalez, 2011; Weiss-Cohen, Konstantinidis, Speekenbrink, & Harvey, 2016). In a powerful analysis of 14 choice anomalies, most of the well-known description-based choice phenomena were found to be eliminated or reversed after a few experienced-based choices with feedback; the authors concluded that "the quantitative effect of experience can be large … even when the decision makers can rely on complete description of the incentive structure" (Erev et al., 2017, p. 393; see also Jessup, Bishara, & Busemeyer, 2008; Lejarraga & Gonzalez, 2011). Finally, moving from the lab to the field, a review of the risk perception of natural hazards showed that personal experience and the lack thereof constitute "a strong factor in risk perception" (Wachinger, Renn, Begg, & Kuhlicke, 2013, p. 1059).

Neither Experience Nor Description: Unknown Territory

In this epistemic state neither descriptions nor experience exist (Figure 2, lower left cell) This state is perhaps best captured by the notion of "unmeasurable uncertainty" initially developed by Knight (1921) and Keynes (1937, 1973; see also Kozyreva & Hertwig, 2019). Unmeasurable uncertainty arises when there is no valid system of classification and no empirical evidence on the basis of which numerical measures can be assigned to one's degrees of belief. This is unknown territory—no experience has been gathered and no description of the probability structure of the risky phenomenon in question is possible. Here, research on the description–experience gap is mute. This may have been the epistemic state researchers in Wuhan found themselves in when reports of a new infectious disease (COVID-19) began to emerge. Initially, there was no valid basis for testing and classifying patients or tabulated evidence allowing epidemiologists to judge the disease's key parameters. In situations of unmeasurable uncertainty, one may hope to draw on simple heuristics (e.g., win-stay, lose-shift) and on knowledge gathered in the past or by others (vicarious learning). But any kind of mapping and similarity relationship—is the new virus more like a common cold or more like MERS?—involves navigating the twilight of uncertainty.

New Research Questions

Our key point is that human responses to risks—complex, sometimes contradictory, sometimes even self-defeating—will be better understood and predicted if researchers begin to systematically examine and model the dynamic between the two modes of learning about risks. The description–experience framework we have outlined gives rise to a number of interesting research questions, including the following.

Can Experience Help to Explain Perplexing Inconsistencies in Response to Risk?

Examples of puzzling human responses to risk abound. South Koreans who vigilantly fight COVID-19 but blithely brush aside the prospect of nuclear annihilation are just one example (Sang-Hun, 2020). The description–experience framework suggests that one promising starting point for understanding such puzzles is to ask: What have people experienced? Relatedly, how does that experience systematically diverge from another party's purely descriptive information?

When and Why Do Risk Warnings and Preventive Measures Fail?

Experts and laypeople often do not see eye to eye about a given risk (e.g., Bostrom, 1997; Sjöberg, 1999). For instance, nearly 800,000 residents live in the red zone of Europe's "ticking time bomb" (Barnes, 2011, p. 140), Mount Vesuvius, despite dire warnings from volcanologists (Mastrolorenzo, Petrone, Pappalardo, & Guarino, 2010; Mastrolorenzo, Petrone, Pappalardo, & Sheridan, 2006) and cash bonuses for moving (Barberi, Davis, Isaia, Nave, & Ricci, 2008; Bruni, 2003). One possible reason, which has been demonstrated experimentally (see Barron et al., 2008), is that the power of warnings wane if they are counteracted by repeated "all clear" experience. Most residents in the red zone have never experienced Mount Vesuvius erupting—the last effusive eruption was in 1944.

How Can (Lack of) Experience Undermine Prevention and Is Simulated Experience A Cure?

Poor vaccination coverage has recently resulted in measles outbreaks in many parts of the world (UNICEF, 2019). During the first six months of 2019, for instance, 364,808 measles cases were recorded in 182 countries—the highest number since 2006 (see Korn et al., 2020). According to the World Health Organization (WHO), 'vaccine hestancy' is one of the ten major threats to public health in 2019 (WHO, 2019). Vaccine hesitancy may be, at least partly, due to an unfortunate collusion of experience and vaccine-critical description. Thanks to the success of preventive measures taken in previous decades, few people in recent generations have been exposed to measles or its effects. They could therefore conclude either that vaccination is a successful measure that should be continued or that concern about measles is much ado about nothing. The description–experience framework indicates that potential overweighting of the very small risk of serious side effects of vaccination may disproportionally affect people's decisions. This raises the question of whether "simulated experience" (Armstrong & Spaniol, 2017; Hogarth & Soyer, 2015; Kaufmann, Weber, & Haisley, 2013) can be used to offer people safe encounters with rare risks as a way of counteracting the effect of all-clear experience.

What Is the Longevity of a Single Experiential Risk Episode?

Traumatic experiences of a catastrophic event—a crime, a financial disaster, a life-threatening disease—can last. Even after their repercussions have receded, these experiences shape behavior (remember the Depression-babies effect; Malmendier & Nagel, 2011), especially when new experiences are avoided or are otherwise unavailable to balance the original experience out. One important research question for the future is to track the psychological weight of a risk event across time (Figure 3). For instance, a recent analysis of nearly 1,300 settlements and their experience of major floods found that "respect for floods waned in the second generation" (Fanta, Šálek, & Sklenicka, 2019, p. 2), which is when people moved from safer sites back toward to the river.

Conclusions

The COVID-19 pandemic is a forceful reminder that coping with risks requires not only scientific measures such as precautionary interventions, but also an informed and cooperative public. Yet responses to risks often seem puzzling. One reason is that people's mental models of risk are richer than those assumed in the common technological definitions (see Slovic, 1987). Another is that people's knowledge of risks stems from two imperfect teachers: descriptions and experience. Each implies distinct ambiguities and psychological effects. Comprehending the two and the dynamics of their co-occurrence will enrich the understanding of people's responses to risks—as well as the ability to predict and guide those responses

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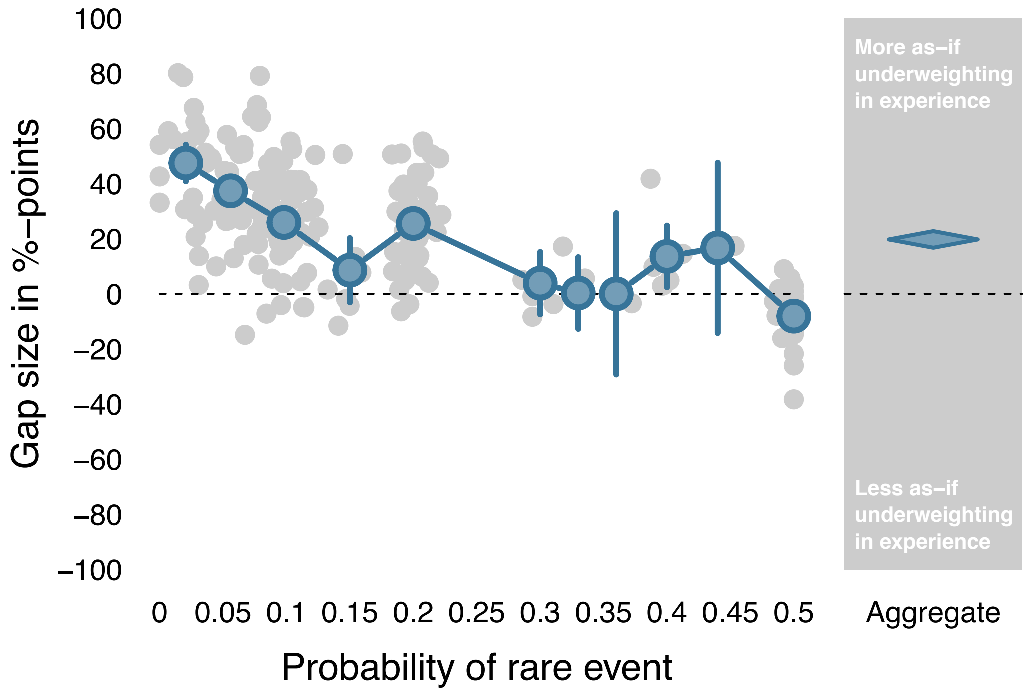

Figure 1. The description–experience gap as a function of the probability of a rare event. The figure displays the differences in the proportion of description- and experienced-based choices. Values larger than zero indicate more as-if underweighting in experience than in description (adapted from Wulff et al., 2018, Figure 3). Dots show the aggregate results for bins of size .04 in terms of the true probability of the rarest event and standard errors based on random effects meta-analysis.

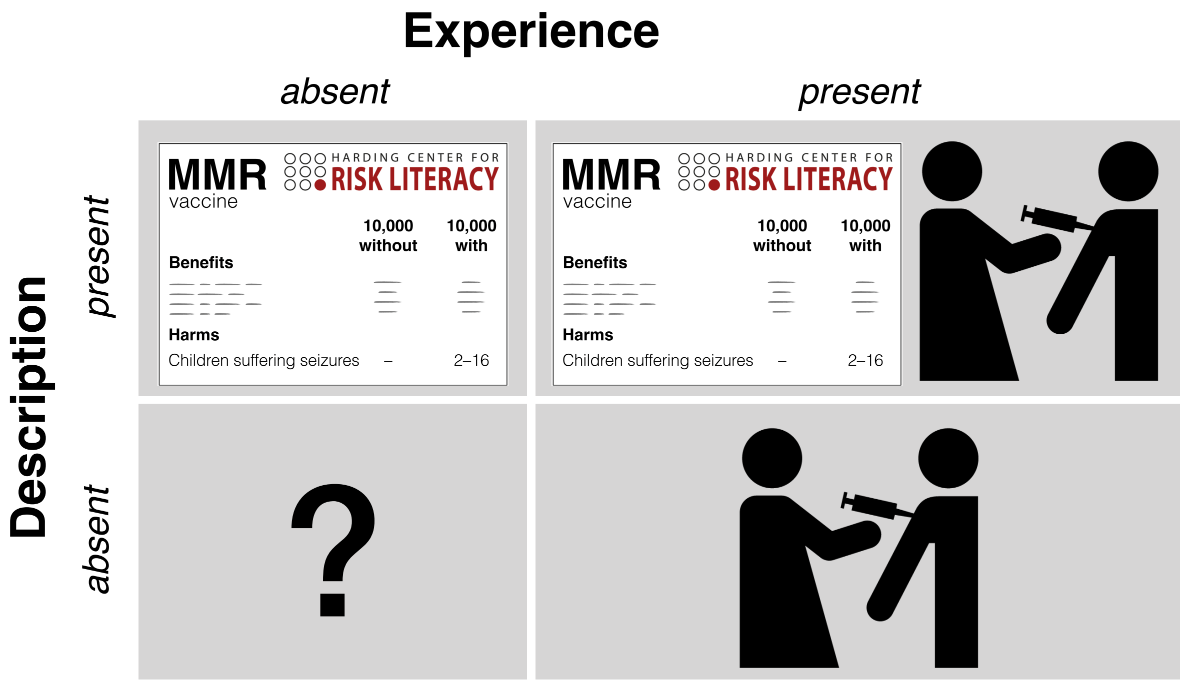

Figure 2. Fourfold pattern of epistemic states in the risk event of vaccinating one's child against measles, mumps, and rubella (MMR vaccine). The fourfold pattern of epistemic states arises from the absence/presence of personal experience (vaccination icon) or stated descriptions (fact box) on the benefits and harms of vaccination. The stylized MMR Fact Box was modeled with permission from the Harding Center for Risk Literacy on the original MMR Fact Box (Harding Center for Risk Literacy, 2016).

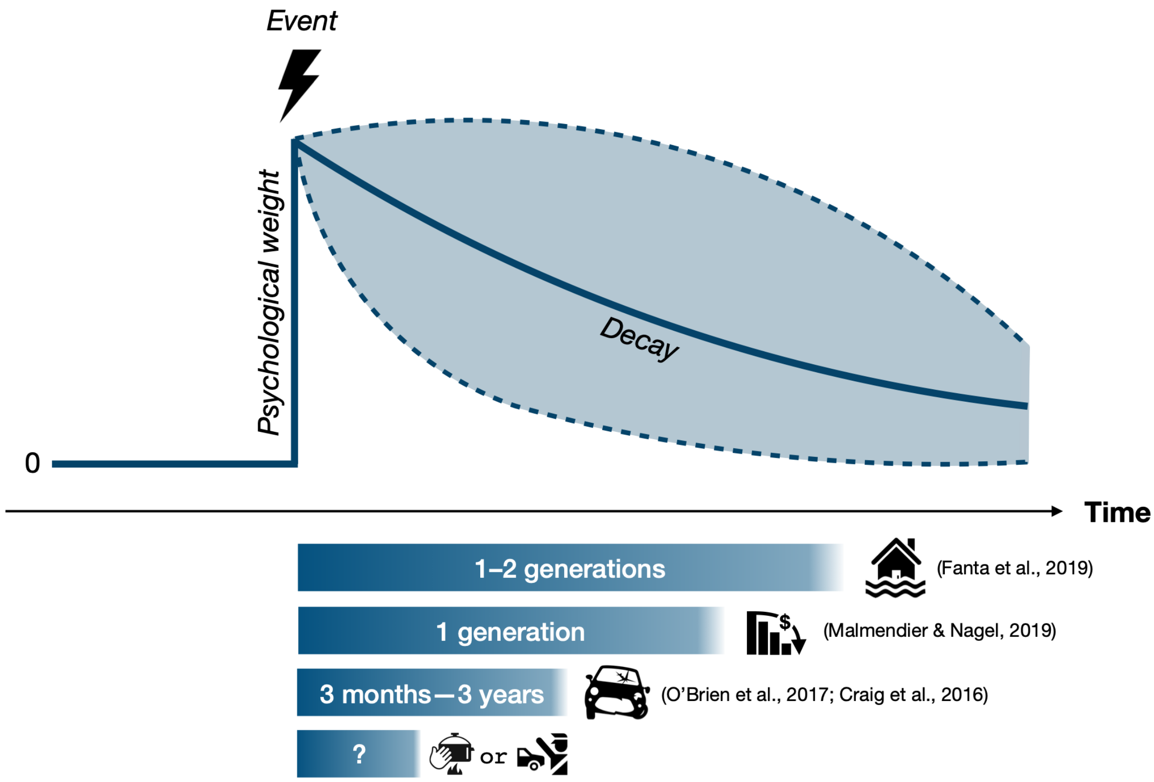

Figure 3: Psychological weight across time. The prototypical time course of psychological weight assigned to an event by an individual or a group of individuals in response to having experienced it. Psychological weight decays differently depending on the type of event. For instance, decay in collective memory of cultural goods, such as music, typically follows a bi-exponential form (Candia, Jara-Figueroa, Rodriguez-Sickert, Barabási, & Hidalgo, 2019), whereas individual memory decay is typically assumed to follow a simple exponential form (Schooler & Hertwig, 2005). Recent empirical evidence also highlights that memory biases in favor of extreme events contribute to the description–experience gap (Madan, Ludvig, & Spetch, 2017).