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The Relative Weights of Direct and Indirect Experiences in the Formation of Environmental Risk Beliefs[*]

by

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Abstract

Environmental risk beliefs may be governed more by direct experiences than by indirect experiences derived from outcomes experienced by others. This emphasis could have a rational basis or could be based on behavioral rationales in terms of the well-established Availability Heuristic or the Vested-Interest Heuristic, which we introduce in this paper. Using original data from a large, nationally representative sample, this article examines the perception and responses to morbidity risks from tap water. Direct experiences have a stronger and more consistent effect on different measures of risk belief. Direct experiences also boost the precautionary response of drinking bottled water, while indirect experiences do not. These results are consistent with the hypothesized neglect of indirect experiences in other risk contexts, such as climate change.

Keywords: risk beliefs, experience, perception, tap water

JEL codes: D80, Q53, I12, K32

1. INTRODUCTION

Individuals often make personal decisions – should they install a water purifier, should they move to a more convenient apartment where air pollution is worse -- that require that they assess risks. Rarely do they conduct research, though that might be desirable. They usually simply decide on the basis of their own experiences and the experiences of others.

This paper considers perception of risks from drinking tap water and asks: "When making risk assessments, how much do individuals rely on their own experiences and how much on the experiences of others?" In most instances, we would expect the latter to be much more extensive, hence much more informative.

A quite substantial literature has assessed the effect on risk beliefs of warnings, labels, and a wide variety of public information efforts. These studies have included studies of chemical labeling for workers,[(1)] labels for household chemicals and pesticides,[(2,3)] organic product labels,[(4)] radon risk information from a variety of sources,[(5,6,7,8)] well water test results,[(9)] reports on drinking water quality and standards,[(10,11)] general and household-specific information on nitrate risks in water,[(12)] incorporation of scientific information about arsenic risks in water in risk beliefs,[(13)] and product recall publicity for pet food and lead-painted toys.[(14)] These studies, like those here, focus on people's ability to acquire information and update their risk beliefs. That personal experience affects risk beliefs is well-established. Workers who have been injured at work view their jobs as more hazardous;[(15)] earthquake survivors assess future earthquakes as more likely;[(16)] and similarly for the risks of hurricanes,[(17)] and red tides.[(18)] Personal health shocks affect smokers' beliefs.[(19)]

Others' experiences may alter risk beliefs as well, but the extent of influence is unclear and may vary depending on the context.[(20)] Both own and other's experience influence perceptions of product risks.[21] For floods, direct experience weighs much more heavily than community or vicarious experience.[22] Similarly, direct flood losses rather than generic experience of a disaster promotes behavior to mitigate flood losses.[23] If people do rely disproportionately on own experiences relative to other's experiences, broad policy consequences follow. Such a bias may contribute to a failure to adequately assess the risks of climate change.[24]

A variety of tendencies may lead one to under value others' experiences, or even disregard them completely, when forming risk assessments. People may overestimate the extent to which their experiences indicate general risks; when assessing the general population's risks, they may overvalue their own experiences relative to those of others. These and related factors contribute to an "empathy gap."[25] Behavioral propensities--such as relying on one's own information much more heavily than that of others--may override sensible approaches to risk assessment. To illustrate, the Availability Heuristic reveals that, when instances can easily be brought to mind, a phenomenon is viewed as more common. One's own experiences are much more available, and therefore, more influential in determining risk assessments. Indeed, there is disturbing evidence that physicians, in making decisions, primarily rely upon their own experiences, secondarily upon the experiences of colleagues, and only third upon the literature. Hertwig et al.[20] draw a useful distinction between decisions where individuals have external information sources, such as newspapers or mutual fund brochures, and those where they draw on their own past experiences, such as whether to back up their hard drive or whether they accept a blind date. They identify a number of biases in own-experience decisions, notably underweighting rare events, a bias of potential importance for many environmental risks.

This paper examines the assessments and decisions made by a nationally representative cross-section of American adults estimating their risks of getting sick from tap water in their homes. This risk is consequential. There are somewhere between 12 million and 20 million cases of waterborne disease in the United States annually.[26] Though most illnesses are brief, and full recovery is normal (except in particularly vulnerable groups), their common occurrence makes them a significant health-policy concern. Their frequency also creates a splendid opportunity for determining how individuals, drawing upon their own personal experiences and upon reports from others about their experiences, assess a risk.

Consider the classic situation of observing trials from a Bernoulli urn. Our formulation, which utilizes a Bernoulli urn model as the reference point and a beta distribution to analyze risk beliefs, parallels that in many previous studies.[1,2,5,19,27] To make inferences about the color composition in the urn, risk beliefs should be the same whether draws from the urn are made by the individual or by another person who then reports to the individual.

In life, however, experiences with risk are the far from crisp draws of balls from that Bernoulli urn. One's own experience may be processed quite differently from an experience reported by others. Our minds work as though each participant has a different urn. This paper assesses how individuals, in evaluating and responding to the risk of illness from tap water, weight their own experiences relative to those reported by others. More specifically, it examines whether individuals adequately weight reports from others. This class of concerns is related to the recent literature on social influences and decisions involving risk.[28]

A standard Bayesian learning framework provides our benchmark. We invoke Bernoulli trials, and a beta distribution for prior beliefs characterized by two parameters, b and c. Binary chances yield a success or failure, but in our context the "success" event is getting a water-related illness. The prior probability of success in this urn model is b/c, equivalent to observing b successes in c trials. After making n draws from the Bernoulli urn and observing m successes, the posterior probability based on this information becomes (b + m)/(c + n). Of course, if flipping a coin, the prior weights would be much more substantial; b might be 5,000 and c 10,000. There would be virtually no update in the probability from just a few trials.

We address the perceived probability of getting sick from drinking tap water; experience would change probabilities significantly. People who had never gotten sick from tap water would have a much lower estimate than those who had. Posit that someone starts with a prior with b = 3 and c = 10, implying a prior probability of 0.3 from getting sick from tap water. (This is roughly the proportion of those in our sample who report having been sick from drinking water.) Let one experience be either m = 0 (not sick) or m = 1 (sick) in a single trial where n = 1. Thus, one past illness experience would boost the posterior probability to 4/11; its avoidance would reduce the probability to 3/11. Note, 3/10, the initial probability, equals (3/10)(4/11) + (7/10)(3/11); the expected posterior probability must equal the prior probability. Of course, if prior beliefs more definitively determined the posterior probability, c would be much larger relative to n. If one's own experience weighed more heavily in the posterior assessment, personal sickness would represent a much larger m value, with n proportionately larger as well.

Our survey question asks whether the individual has ever gotten sick from drinking their own home's tap water. It tracks neither the number of illnesses nor the number of trials (as reflected in the total amount of tap water the person has drunk). It thus combines reports from individuals who have gotten sick only once with those who have gotten sick many times. The same is true of reports from others. Thus, we implicitly treat personal sickness and reports of sickness from others as comprising the same number of both trials and illnesses. If anything, experiences from others would contain more information, given that most people would have heard of sickness (or the lack thereof) from many people. One's own experiences are called *direct*; experiences reported by others are *indirect.*

Do individuals treat direct and indirect reports as equivalent? Let m_1 and n_1 be the values of illness events and total trials for oneself. Posit that reports from others are informative in the same way, but may be given a weight w that is greater or less. This is a simplification. If individuals get reports regarding sickness from many others, the absence of sickness would be strongly informative ($m = 0$, n large), since it would be greatly surprising, whereas a report of sickness from at least one outsider would tell little (m small, n large), since it is to be expected. In practice, this simplification works against our finding that reports from others, whatever the result, have little influence. Thus, after "observing" m_2 illnesses in n_2 trials for others, the person applies a weight w to these values when forming the posterior assessment. Then, drawing on both sources, an individual's posterior probability of illness is $(b + m_1 + wm_2)/(c + n_1 + wn_2)$. If the weight $w=0$, others' experiences play no role in forming risk beliefs. If the weight w [< 1][=1][>1], others' experiences count [less than][equal to][more than] one's own. Our empirical analysis seeks to determine the implicit value taken by w.

Section 2 outlines our hypotheses. Section 3 describes our sample illness-related questions. Section 4 analyzes how risk beliefs relate to personal and indirect experiences. Section 5 considers the behavioral responses to illness experiences. Our results, as elaborated in concluding Section 6, show that people know substantial amounts about the risk-related experiences of others. Nevertheless, the overwhelming contributors to people's risk beliefs and risk-averting behaviors are their direct experiences; indirect knowledge weighs much less.

2. HYPOTHESES

Indirect experiences of others might well weigh much more heavily in an individual's risk assessment than direct experiences. Most people have at least several friends, which gives them access to a much more extensive data set. Additionally, illness from tap water is likely to be discussed among friends. Indeed**,** more subjects report friends' tap-water illnesses (58.8%) than their own (28.8%). This result suggests that there is more information about sickness from indirect than from direct experience.

We hypothesize, however, that individuals give less weight to indirect knowledge than to direct knowledge of tap-water-related illness. There are three reasons, the first fully rational, the latter two behavioral.

A. *Different exposure and vulnerability*. Individuals should think, correctly, that a personal occurrence of illness predicts their future risk more than an occurrence to another. Others may have tap water from a different source, different residential plumbing, or different susceptibility to water-borne illness.

B. *Availability Heuristic*. The Availability Heuristic, one of the most thoroughly documented phenomena in behavioral decision, finds that people tend to judge the frequency of an event by how easily they recall specific instances.[29] It surely applies here. In contemplating gastrointestinal illness from tap water, any past victim can readily bring to mind graphic memories of visceral misery. By contrast, the experiences of others are much harder to summon. The "empathy gap" reinforces this disparity; events that happen to oneself have greater emotional weight than the same events happening to others.[25]

C. *Vested-Interest Heuristic*. In everyday discourse, people regularly provide information that we factor into our decisions. In many situations, those others also have an interest in the decisions that we make. They might be job applicants hoping to impress us, friends trying to persuade us to their political views, or salesmen trying to sell an item. In such situations, we expect others to exaggerate or selectively reveal information favorable to the choices they prefer us to make. Alert to others' potential vested interests, we discount the information they provide. Individuals in dyads underutilize information from collaborators, even though their interests are fully aligned.(30)

The Vested-Interest Heuristic arises because, as with other heuristics, sensible behavior in a wide variety of contexts carries over to situations where that behavior is inappropriate. The devaluing of information from vested others could carry over to situations where the other individual was indifferent to one's decision, or had completely compatible interests. For example, a friend recounting an illness from tap water is unlikely to have an interest beyond the purely altruistic in raising one's assessment of the risk from tap water. However, one might inappropriately employ this heuristic, and devalue or ignore entirely the friend's information. A related phenomenon may come into play. If the friend is selling a house, then disclosing the health risks from the tap water in the house would be undesirable. Either withholding the information about being sick from the tap water or minimizing the severity of the symptoms would be the preferable strategy if money were the sole object. Knowing that others might withhold or misrepresent experiences would also make indirect experiences less credible.

These three explanations lead to our major hypothesis:

> ***Hypothesis 1***: In assessing risk levels from tap water, individuals will attach much less weight to indirect experiences than to their own direct experiences.

If Hypothesis 1 is supported, we would expect direct experience also to have a stronger influence on actual choices in relation to tap water, such as whether to use bottled water. This leads to the subsidiary hypothesis:

> ***Hypothesis 2***: In making choices to reduce exposure to tap water, individuals will attach much less weight to indirect experiences than to direct experiences, even after accounting for risk levels.

Our empirical study focuses on the relative weights assigned to direct and indirect information regarding risks of illness. We make no attempt to determine comparative contributions of our three possible explanations for why indirect information is discounted in determining risk beliefs or risk-related behaviors. Such a comparison would be a fruitful subject for future research.

3. DATA DESCRIPTION

Our data set is an original survey drafted the authors commissioned and administered from Knowledge Networks in 2009. The survey questions were part of the authors' larger national study regarding hazards from drinking home tap water. This Internet-based sample is a nationally representative adult (18 years and over) sample, generated using a probability-based sampling approach. The survey firm ensured representativeness by providing Internet access to enable households without computers to participate. The sample's characteristics closely matched those of the adult U.S. population. See Appendix Table AI. The survey elicited measures of the subjects' direct and indirect experiences with their homes' tap water, as well as several measures of risk beliefs. While some survey questions used the term "drinking water," the text made clear that all such questions pertained to tap water in their homes. “In this survey we will ask you questions about how you value drinking water. When we say drinking water in this survey, we mean water from the tap in your home.”

Table I summarizes the means and standard deviations of the variables employed. The survey included detailed demographic information on each respondent’s income, years of education, age, gender, and race (black, not white or black, or white, which is the omitted category) and, ethnicity (Hispanic or the omitted category of not Hispanic). Dividing the race and ethnicity categories into a series of mutually exclusive categories creates groups for which the effects are too small to be distinguished in the empirical analysis. Of the 137 respondents who reported Hispanic ethnicity, 111 indicated that their race was white. Only 6 Hispanic respondents also reported being black, while 20 reported other racial groupings, with the most common being multiple races, which was indicated by 17 respondents. The breakdowns by race and by ethnicity without indicating all mutually exclusive groups are comparable to those in government statistics on water quality, cited below, which also report overlapping categories. There were also regional variables for Northeast, South, and West, with Midwest being the omitted category. The sample size throughout was 1,014.

The survey, which was broader in scope than this analysis, focused on the valuation and perception of the morbidity risks of home tap water. The primary questions of interest dealt with respondents’ direct and indirect experiences with tap-water illnesses, their perceptions of tap-water risks, and the precautions they had taken. The survey informed respondents of the different morbidity risks associated with drinking contaminated tap water, and described these ailments’ characteristics. The survey introduced the illness risk as follows: “The most common sickness caused by drinking water contamination is called Gastrointestinal (GI) illness.

Contaminants in water can cause nausea and vomiting, diarrhea, stomach pain, and sometimes a fever. Such illnesses last from 2 to 14 days, but average about a week before all symptoms end." The drinking-water terminology used in the survey referred to the respondents' home tap water.

The focus was on gastrointestinal (GI) risks. After providing information on GI illnesses and their prevalence in the U.S., the survey asked respondents whether they had ever become ill from drinking contaminated tap water in their homes, and if so, which particular symptoms they had experienced. It then asked them whether any of their friends had ever become sick from drinking contaminated tap water at home. The survey also included questions asking whether other family members had become sick from tap water. This variable was strongly related to the respondent's own experiences and served no additional role in the analysis. In particular, for the 290 cases in which the respondent's family had gotten sick from tap water, the respondent also reported a tap water illness in 242 instances, or 83% of the time. This high percentage may have stemmed in part from the survey's instructions to respondents to answer questions on behalf of their households: "For the rest of the survey, when a question refers to you, think of it as referring to you and the members of your family who currently live in your home." Also, families would be much more likely to be drinking from the same tap, and more likely to suffer together from undiagnosed food poisoning or a contagious illness.

The responses to the personal illness question were Yes (3.9%), Not Sure (24.9%), and No (71.2%). To the friends question, they were Yes (5.4%), Not Sure (53.4%), and No (41.2%). As expected, respondents were more often "Not Sure" about water-related illnesses for their friends than for themselves. Since GI illness is not a signature disease, causality is often difficult to ascertain, even for oneself. Given the low frequency of definite Yes responses, our analysis pools the Yes and Not Sure responses.

Table II summarizes the breakdown of responses for the two tap-water illness-experience variables. As noted earlier, the No answer was given less often for friends than for self. Indeed, including Not Sure, subjects reported other persons' (indirect) previous adverse tap-water experiences 30 percent more than direct adverse experiences, slightly more than twice as high. Presumably, given multiple friends and relatives on average, others' experiences provide a much larger sample of potential illness experiences. If individual risk beliefs about tap-water hazards prove to be less responsive to the experiences of others, this can't be due to a failure to be aware of others' experiences.

Before eliciting information on risk beliefs, the survey gave respondents detailed information regarding the frequency of GI illnesses due to tap water. The survey presented this information in multiple forms to help the subjects process the baseline risk information. The risk ranges provided were consistent with acute gastrointestinal illness statistics.[31,32,26] Subjects were told that 15 million Americans became sick annually because of contaminated home-tap-water, and that children and the elderly were the most susceptible age groups. They were also informed that the average annual 0.05 risk probability of GI illness produced 50 cases annually out of a population of 1,000. That survey text was as follows: "Overall, about 50 out of every 1,000 Americans become sick in this way from drinking water each year." To help respondents conceptualize the probability information, the survey showed a 1000-square grid with 50 squares colored red, indicating the proportion of people who got sick from drinking water in the previous year. To put the risk probability in perspective, the survey also included a risk ladder relating tap-water GI risk to the frequency of other hazards, such as dog bites, traffic accidents, and the flu.

After receiving this information, respondents were asked: "Compared to the 50 out of 1,000 average risk for the country overall, do you think that the GI risk of your tap water is: Much Lower Risk, Lower Risk, About the Same Risk, Higher Risk, or Much Higher Risk?" Our empirical analysis collapsed these five categories into three by pooling the two above-average risk categories and then the two below-average risk categories. Subjects' perceived risks were above average (6.7%), approximately average (32.2%), and lower than average (61.0%).

Note the preponderant belief that personal risks were average or below. There are two plausible explanations for this pattern of results, which might otherwise suggest that respondents were understating their relative risk levels. First, tap-water risks are highly unevenly distributed across the country.[1] The concentration of risks skews outcomes so the mean risk exceeds the median risk. Moreover, some population groups -- particularly the elderly, people with compromised immune symptoms, minorities, apartment dwellers, and residents whose homes or local utilities have ancient pipes and plumbing – are at greater risk. The concentration of minorities in rental housing elevates their risks. Supporting data are from the U.S. Department of Housing and Urban Development,[(33)] Tables 3-4 and 4-4. Minorities exhibit greater perception of the relative safety of bottled water as compared to tap water.[(34)] Given such concentrations of the risk distribution, a characteristic of many classes of risks, accurate perceptions by respondents would have most in the below average category. Second, a framing effect could combine with optimism bias to contribute to the observed pattern of results: People do not want to be viewed as worse off than their neighbors.[(2,35)]

The two other measures of risk belief examined were 0-1 indicator variables asking respondents whether they had ever been afraid to drink their homes' tap water, "Have you ever

[1] Statistics on the substantial heterogeneity of water quality violations are summarized by the Environmental Working Group at http://www.ewg.org/tap-water/reportfindings.php.

gotten water from your tap that you were afraid to drink due to concerns about its safety?" and whether they believed bottled water to be safer than their tap water. About one-third of the sample had, at some time, been afraid to drink their home's tap water due to safety concerns. The question asking respondents to compare their tap-water risk to the bottled-water risk established a different reference point for assessing the riskiness of tap water, rather than the national average risk from tap water. The risks from bottled water will be lower than the average tap-water morbidity risk (though tap water will be equally risky as water from facilities in compliance with government standards). Therefore, the percentage of the sample that believed that their risk from tap water exceeded a zero-risk bottled-water reference point should have been greater than the percentage that believed that their risk level was higher than the national average tap-water risk. But if tap water meets regulatory guidelines, there are no significant safety benefits from drinking bottled water.[36] People with compromised immune systems or whose public water system is contaminated should drink bottled water.[37] Consistent with our posited relationship, 32.1% of the sample viewed bottled water as safer than their tap water, even though only 6.7% of the sample considered their risk levels to be above the national average risk.

Finally, the survey elicited information related to risk-reducing behaviors; whether the respondent used bottled water and whether the respondent used water filters. Their answers should be positively related to adverse direct and indirect illness experiences and to greater risk beliefs based on such experiences.

4. ILLNESS EXPERIENCES AND RISK BELIEFS

We examine how tap-water experiences affect three risk-belief variables. We initially focus on raw proportions, and then conduct regression analyses to provide statistical tests and control for demographic characteristics. In each case, two positive relationships emerge: the first between the subjects' direct experiences and the subjects' risk beliefs, and the second between the subjects' indirect experiences and those beliefs. In accord with Hypothesis 1, indirect experiences affect fewer risk-belief variables and are of lesser magnitude than direct experiences.

Table III shows how various experience groups perceived their risks compared to the national tap-water morbidity risk. Of the Yes/Not Sure direct-experience group, 49% believed that they faced GI risks below the national average, compared with 66% of their No counterparts. Indirect experiences produced a similar but less pronounced pattern. Of the Yes-Not Sure group, 59% held below-average risk beliefs, compared with 64% of the No group.

The patterns across the columns are also consistent. The percentage of the sample in each of the risk-belief categories rises as one moves across Table III's columns. The differences between the values in the lower-risk belief column and the higher-risk belief column is less for those indicating either direct or indirect adverse experiences, as one would expect if risk experiences shift risk beliefs toward a higher-risk category.

Table IV's two binary risk-belief variables also indicate an apparent influence of adverse tap-water experiences on risk beliefs. Those with direct experience were 15.5% more likely to be afraid of tap water than those without. For indirect experience, the difference was 12.7%. The respective gaps for bottled water being safer than tap showed the same pattern, 12.3% and 7.3%.

Tables III and IV show results consistent with Hypothesis 1: among individuals who think their tap water poses an above-average risk, personal experience produces higher values than indirect experience. Three regressions in Table V enable us to isolate the influence of either experience variable specifically and assess the incremental effect of experience controlling for other personal attributes. Each regression tests for the effects of direct and indirect experiences on risk beliefs. Regression results omitting the demographic variables yield very similar effects in terms of their magnitude and statistical significance. Indirect experiences never have a statistically significant effect. The dependent variables are whether the respondents believe themselves to be exposed to relatively greater tap-water risks relative to the rest of the country, have ever been afraid to drink their tap water, and believe that bottled water is safer than tap. Table V reports probit regression estimates. Its coefficients have been transformed to correspond to the marginal effect each variable exerts on the pertinent probability.

Direct experiences consistently significantly increase risk beliefs. Indirect experiences only do so for "afraid of home tap water." There the marginal effects are large -- 0.11 (direct) and 0.08 (indirect) – relative to the 25% of the population expressing this fear. Direct experiences boost by 0.09 the probability that the respondent believes that bottled water is safer, which is substantial relative to the 0.32 probability for the population. If tap water is in compliance with government regulatory standards, bottled water is not safer.(36)

The other explanatory variables included in the risk-belief equations reflect expected patterns. Black respondents and poorer respondents have, on average, higher risk beliefs, consistent with their greater levels of exposure to unsafe tap water. There is a documented negative relationship between income and health risks from tap water.(38)

Table V's results strongly support Hypothesis 1. "In assessing risk levels from their homes' tap water, individuals will attach much less weight to indirect experiences than to their own direct experiences." We now test Hypothesis 2, examining how direct and indirect experiences affect individuals' efforts to reduce their exposure to tap water.

5. ILLNESS EXPERIENCES AND PRECAUTIONARY EFFORTS TO REDUCE EXPOSURE

The primary way to reduce one's risks from tap water is to reduce one's exposure. Precautionary actions reveal how tap-water experiences affect actual choices, such as drinking bottled water from small bottles, gallon jugs, or water coolers, as does 67% of the sample. Water filters geared to the whole house, the tap, or a pitcher represent a safety measured used by 38% of the sample.

Table VI shows that illness experiences increase precautionary behaviors. For bottled water, the values are 7.8 percentage points (direct) and 4.5% (indirect). Water filter use shows a similar absolute gap, 7.5% (direct) and 5.0% (indirect).

The first two columns of Table VII employ regressions to test Hypothesis 2. The probit regression results show that direct experiences significantly increase the use of precautionary behaviors – bottled water by 0.06 and water filters by 0.07 -- whereas indirect experiences do not. After controlling for demographic variables, the effect of direct experiences, though positive, only remains significant at the 0.10 level based on a one-tailed test. This loss of significance after demographic controls is not surprising. Posit the extreme case, where adverse effects were the true causal variable, but were fully concentrated in some demographic groups. After controls, adverse effects would show zero effect.

These results support Hypothesis 2. "In arriving at behavioral choices to reduce exposure to tap water, individuals will attach much less weight to indirect experiences than to their own direct experiences, even accounting for risk levels."

The regressions in Table VIII examine whether risk beliefs predict precautionary behaviors. Table V showed that direct water illness experiences raise risk beliefs, hence the potential for a two-step explanation. The results are similar both with and without demographic controls. Those who believe that their tap water risks are above average, have ever been afraid to drink their tap water, or think bottled water is safer, use bottled water significantly more often. Water filter use does not show a comparable effect, perhaps due to the small sample size and the less frequent use of water filters. As expected, people at higher income levels are greater users of bottled water and filters.

6. CONCLUSIONS

Individuals learning about drinking water risks give significantly more weight to their personal experiences than they do to the experiences of others. This imbalance arises though others collectively have far more experience. We suggest three explanations for such behavior, one rational, as individual experiences may better reflect particular individual circumstances. The other two explanations have strong behavioral underpinnings. The well-established Availability Heuristic reveals that since the salience of own experiences brings them readily to mind, they are given excess weight in probabilistic assessment. The Vested-Interest Heuristic, presented here, leads individuals to underweight information from others, because those others often have interests that differ from our own. Presumably, this heuristic carries over to situations where there is no misalignment of interests.

Two hypotheses flow from our explanations. They posit that individuals will underweight information from others relative to their own when assessing the risks of drinking tap water, and when making choices – such as purchasing bottled water – that reduce their tap-water risks. Our data support both hypotheses.

The health risks of tap water are important for the health losses they impose, and for the costs individuals incur to avoid such losses. It seems likely that many individuals substantially misestimate those risks. Presumably, more accurate assessments across individuals and locales could lead to both fewer health losses and lower protective expenditures.

In addition, the failure to learn sufficiently from the information of others has profound implications across a broad array of issues. Tap water served as our case study because the risks are reasonably common, and we could design a survey with well-specified questions that could elicit risk outcomes and risk beliefs. Extrapolating our findings to other contexts would suggest that people who have not had direct experiences with the adverse effects of floods, hurricanes or climate change would assess these risks below those who have had direct experiences. Outside the environmental risk area, doctors will employ the wrong treatments, and spouses and business partners will remain at odds though their shared information should lead to agreement. The problem is compounded, of course, when interests diverge. For example, international agreements will not be reached, and labor disputes will fester, because the parties cannot agree on facts.

Decisions made about tap water would seem to be simple and straightforward. Yet strong behavioral biases afflict them. Presumably those biases will also afflict decisions that individuals must make where the risks are far more consequential.

Table I
Summary Statistics of Variables[a]

	Mean	Std. Dev.
Respondent Ever Sick From Tap Water (Yes or Not Sure)	0.2880	0.4530
Friend Ever Sick From Tap Water (Yes or Not Sure)	0.5878	0.4925
Believe Above-Average Risk From Drinking Tap Water	0.0671	0.2503
Believe Average Risk From Drinking Tap Water	0.3225	0.4677
Believe Below-Average Risk From Drinking Tap Water	0.6105	0.4879
Ever Afraid to Drink Tap Water	0.2495	0.4329
Believe Bottled Water Safer than Tap Water	0.3205	0.4669
Use Bottled Water	0.6677	0.4713
Use Filtered Water	0.3787	0.4853
Age	49.6322	16.0952
Gender: Female	0.5128	0.5001
Race: Black	0.1243	0.3300
Race: Not White or Black	0.0621	0.2415
Race Data Missing	0.0079	0.0885
Hispanic	0.1351	0.3420
Income / $10,000	6.1294	4.2563
Top Income Category ($175,000 or more)	0.0237	0.1521
Years of Education	13.8018	2.5800
Northeast	0.1844	0.3880
South	0.3225	0.4677
West	0.2367	0.4253

[a] Sample size is 1,014.

Table II
Illness Experiences with Home Tap Water

	N	Percentage
Ever Sick from Tap Water		
Yes or Not Sure	292	28.8 %
No	722	71.2 %
A Friend Ever Sick from Tap Water		
Yes or Not Sure	596	58.8 %
No	418	41.2 %

Table III
Tap-Water Illness Experiences and Risk Beliefs Relative to National Average

	N	Higher GI Risk	Average GI Risk	Lower GI Risk
Ever Sick from Tap Water				
Yes or Not Sure	292	11.0 %	40.1 %	49.0 %
No	722	5.0 %	29.1 %	65.9 %
Friend Ever Sick from Tap Water				
Yes or Not Sure	596	7.7 %	33.6 %	58.7 %
No	418	5.3 %	30.4 %	64.4 %
Total	1,014	6.7 %	32.2 %	61.0 %

Table IV
Tap-Water Illness Experiences and Tap-Water Risk Perceptions

	N	Afraid of Water	Bottled Water Safer
Ever Sick from Tap Water			
Yes or Not Sure	292	36.0 %	40.8 %
No	722	20.5 %	28.5 %
Friend Ever Sick from Tap Water			
Yes or Not Sure	596	30.2 %	35.1 %
No	418	17.5 %	27.8 %
Total	1,014	25.0 %	32.1 %

Table V
Probit Regressions for Risk Belief Variables[a]

	Relative Risk Beliefs	Afraid of Tap Water	Bottled Water Safer
Ever Sick from Tap Water, Yes or Not Sure	0.1612***	0.1126***	0.0931**
	(0.0392)	(0.0351)	(0.0374)
Friend Ever Sick from Tap Water, Yes or Not Sure	0.0007	0.0792***	0.0434
	(0.0360)	(0.0302)	(0.0337)
Income / $10,000	-0.0144***	-0.0073*	0.0017
	(0.0045)	(0.0039)	(0.0042)
Years of Education	-0.0160**	-0.0025	-0.0116*
	(0.0067)	(0.0057)	(0.0062)
Age	-0.0054***	0.0002	-0.0028***
	(0.0010)	(0.0009)	(0.0010)
Gender: Female	0.0363	-0.0186	0.0012
	(0.0317)	(0.0275)	(0.0301)
Race: Black	0.1348***	0.1190**	0.2210***
	(0.0500)	(0.0465)	(0.0495)
Race: Not White or Black	0.0039	0.1359**	0.1315**
	(0.0653)	(0.0651)	(0.0655)
Hispanic	0.0672	0.0354	0.1439***
	(0.0492)	(0.0431)	(0.0479)

[a] Significance levels: *0.10, **0.05, and ***0.01, two-sided test. Standard errors are in parentheses. The regressions also include three regional indicator variables, a top income code variable for those with incomes of $175,000 or more, and a variable identifying 8 respondents with missing race data. Coefficients are transformed to correspond to marginal effects.

Table VI
Precautionary Behavior and Illness Experiences

	Bottled User	Filter User	Total
Ever Sick from Drinking Water			
Yes or Not Sure	72.3 %	43.2 %	292
Not Ever Sick	64.5 %	35.7 %	722
A Friend Ever Sick from Water			
Yes or Not Sure	68.6 %	39.9 %	596
Friend Not Ever Sick	64.1 %	34.9 %	418

Table VII
Probit Regressions for Precautionary Behavior and Tap-Water Illness Experiences[a]

	Bottled Water User	Water Filter User	Bottled Water User	Water Filter User
Ever Sick from Tap Water, Yes or Not Sure	0.0694** (0.0353)	0.0620* (0.0377)	0.0546 (0.0363)	0.0578 (0.0384)
Friend Sick from Tap Water, Yes or Not Sure	0.0170 (0.0334)	0.0254 (0.0344)	0.0425 (0.0343)	0.0313 (0.0351)
Income / $10,000			0.0225*** (0.0044)	0.0107** (0.0043)
Years of Education			-0.0045 (0.0063)	0.0189*** (0.0065)
Age			-0.0031*** (0.0010)	0.0003 (0.0010)
Gender: Female			0.0926*** (0.0303)	-0.0318 (0.0311)
Race: Black			0.2028*** (0.0358)	-0.0150 (0.0483)
Race: Not White or Black			0.0023 (0.0629)	0.0624 (0.0669)
Hispanic			0.0905** (0.0427)	0.0765 (0.0484)

[a] Significance levels: *0.10, **0.05, and ***0.01, two-sided test. Standard errors are in parentheses. The detailed regression also includes three regional indicator variables, a top income code variable for those with incomes of $175,000 or more, and a variable identifying 8 respondents with missing race data. Coefficients are transformed to correspond to marginal effects.

Table VIII
Probit Regressions of Precautionary Behavior and Risk Beliefs[a]

	Bottled User	Filter User	Bottled User	Filter User
Believes Own GI Risk Average or Higher	0.0550* (0.0317)	0.0046 (0.0325)	0.0649** (0.0328)	0.0291 (0.0339)
Ever Afraid to Drink Tap Water	0.1115*** (0.0351)	0.0247 (0.0374)	0.1341*** (0.0346)	0.0384 (0.0385)
Bottled Safer Than Tap	0.2941*** (0.0281)	0.0051 (0.0350)	0.2813*** (0.0287)	0.0038 (0.0360)
Income / $10,000			0.0253*** (0.0045)	0.0108** (0.0044)
Years of Education			-0.0002 (0.0063)	0.0199*** (0.0065)
Age			-0.0020** (0.0010)	0.0004 (0.0010)
Gender: Female			0.0989*** (0.0306)	-0.0330 (0.0311)
Race: Black			0.1568*** (0.0398)	-0.0210 (0.0486)
Race: Not White or Black			-0.0637 (0.0699)	0.0585 (0.0671)
Hispanic			0.0558 (0.0455)	0.0759 (0.0486)

[a] Significance levels: *0.10, **0.05, and ***0.01, two-sided test. Standard errors are in parentheses. The detailed regression also includes three regional indicator variables, a top income code variable for those with incomes of $175,000 or more, and a variable identifying 8 respondents with missing race data. Coefficients are transformed to correspond to marginal effects.

Appendix. Sample Comparison

Table AI
Comparison of 2009 Sample to the National Adult Population[a]

Demographic Variable	U.S. Adult Population Percent	2009 Survey Participants Percent
Gender		
Male	48.7	48.7
Female	51.3	51.3
Age		
18 - 24 years old	13.1	7.5
25 - 34 years old	17.9	11.9
35 - 44 years old	17.9	17.8
45 - 54 years old	19.2	21.0
55 - 64 years old	15.0	23.0
65 - 74 years old	8.9	13.2
75 years old or older	8.1	5.6
Educational Attainment (25 and older)		
Less than HS	13.3	11.4
HS Diploma or higher	57.2	57.4
Bachelor's degree or higher	29.5	31.2
Race / Ethnicity		
White	80.9	80.6
Black/African-American	12.2	12.4
Other	6.9	6.2
Hispanic	13.6	13.5
Household Income		
Less than $15,000	12.9	12.3
$15,000 to $24,999	11.8	8.4
$25,000 to $34,999	10.9	10.7
$35,000 to $49,999	14.0	16.4
$50,000 to $74,999	17.9	20.9
$75,000 to $99,999	11.9	14.3
$100,000 or more	20.5	17.0

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