In *The Future of Risk Management*, Howard Kunreuther, Robert J. Meyer, and Erwann O. Michel-Kerjan, eds. Philadelphia: University of Pennsylvania Press, 2019, pp. 227-248.

CHAPTER 13

Efficient Warnings, Not "Wolf or Puppy" Warnings

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Warnings are a major instrument that the government employs to control losses from risks. On an everyday basis, we will see, for example, warning labels on cigarettes, notices of the carcinogenic potential of items we are likely to encounter, posted signs when we are in falling rock zones, and if watching television, a litany of side effects that accompany ads for prescription drugs.

Although warnings for widely used products are now quite common, that was not always the case. Warnings requirements initially focused on exposures that posed immediate and toxic hazards. The 1927 Federal Caustic Poison Act required that a dozen of the most toxic chemicals, such as sulfuric acid, be labeled "poison." A decade later, the Federal Food, Drug, and Cosmetic Act required the first warnings for food and drugs, where the focus was on imminent hazards and misbranding. Product labeling rules for over-the-counter drugs did not arrive until 1960. The only other prominent warnings requirements at that time were for insecticides and herbicides under the Federal Insecticide, Fungicide, and Rodenticide Act in 1947. The first warnings regulations for products that did not pose a risk of immediate harm came in 1966, when risk warnings became required for cigarette packs. In 1977, Congress required warnings on products containing saccharin, a product that posed minimal dangers relative to products that had required warnings to date. It was not until the 1980s, when occupational hazard communication efforts and environmental right-to-know policies were implemented, that warnings became a more widespread phenomenon.

An academic literature on warnings also began to emerge at that time. Some observers opposed the use of the warnings approach, claiming that it could never promote safety and that direct regulation was preferable.[1] Other studies took a more favorable view of warnings and focused on criteria that would make them an effective regulatory tool.[2] These latter studies stressed the importance of providing new information in a convincing manner, avoiding label clutter, and using a standardized warnings vocabulary. The academic literature also began to recognize the potential risks should warnings proliferate. Such warnings about warnings have had little effect, as the warnings phenomenon has grown rapidly.

Warnings policies, which are less intrusive than command and control regulations, were dubbed "smart disclosure" policies in 2011 by the Office of Information and Regulatory Affairs, then led by Cass Sunstein of *Nudge* fame (written with Richard Thaler).[3] Information provision, in theory, offers significant advantages over the predominant government approach to risk control, namely regulations that specify what can be done and what cannot. With the latter, for example, the Food and Drug Administration (FDA) determines what drugs are allowed on the market. The Environmental Protection Agency (EPA) determines what levels of various pollutants can be dumped in rivers or the atmosphere.

Information provision via the government offers three main advantages: First, given that information is a public good, it is efficient to have a central agent secure that information and then distribute it to others. Second, a major element of risk control entails risk avoidance by individuals. Given that, a one-size-fits-all approach makes no sense. However, given the information on risk provided by the government, individuals, in theory, will be empowered to make wise decisions for themselves. Thus, individuals who highly value a somewhat risky product can choose to purchase it despite its risks. Individuals who value it less will know to avoid it. Individuals will also be at different risk levels, and if effectively informed, high-risk individuals will know to avoid an exposure that low-risk individuals might accept. Third, some decisions by their very nature are decentralized and cannot be readily monitored by the government, such as how a pesticide is used, or whether a prescription drug is taken with food as recommended.

Information provision as a regulatory strategy breaks down, however, if individuals cannot effectively process the information, in which case more prescriptive regulations may be warranted. In some cases, the government simply prohibits a product, as opposed to giving information, presumably

because it thinks that no individual, or at least very few individuals, should purchase it. That is the impetus behind the FDA approach for drugs, or for that matter, making marijuana illegal.

If consumers are relatively heterogeneous, however, the prohibition approach has the strong disadvantage of not securing the benefits of private choice. Thus, it is not surprising that nearly half of U.S. states have recently decided to allow marijuana use for medical purposes, presumably because they think that for an identifiable group of individuals, the benefits of use well outweigh the costs (a few states have made marijuana legal for all.)

For many products, prohibition is too blunt an instrument, and so too is defining certain categories of permissible users. The latter approach fails because within any category that is easily defined, there will be some who if fully informed would like to use the product, and some who would not. To be effective, such categories need to be defined by characteristics such as age or health conditions that can be easily recognized by both the individuals affected and by those enforcing the policies. The difficulties of creating such categories are exemplified by the debate over what constitutes permissible medical use of marijuana or conditions under which individuals may be accompanied by emotional support animals.

Does this not therefore suggest that the government should simply employ a strategy requiring that numerical information be posted, as it does, for example, in identifying caloric or fat content on food labels? The answer would be a confident "yes" if individuals could readily process that information, ascertain their risk levels, assess their benefits, and then make an informed risk-benefit decision. Alas, for all but an exceptional few, utilizing information effectively in this way would be all but impossible. Thus, in many cases the government has chosen neither to provide quantitative risk information directly because it would be too hard for individuals to process, nor to prohibit products because some individuals should be using or consuming them. Instead, it turns to a third strategy: it issues warnings about the risks or, more commonly, requires private parties to post warnings on their products.

In theory, warnings could function in much the same way as information. Individuals, alert to the risks, could make intelligent decisions about whether their personal benefits warranted taking the risk. Before proceeding, we should note the potential nudge feature of warnings. On being alerted that a product brings dangers, but not having its potential benefits highlighted, a warning with respect to the risks of consuming a product or

participating in an activity by itself tends to function as a nudge against consumption. For example, cigarette warnings both convey information and indicate government disapproval of smoking.

Efficient Warnings

A warning inevitably creates benefits and costs. We take a benefit-cost approach to assessing efficiency. Other approaches may lead to qualitatively similar results.

The Anatomy of Warnings

To simplify at the outset, posit that there is only one level of warning. For simplicity, we focus on warnings regarding the discrete decision to use or not use a product. Warnings also may serve a function of providing information with respect to precautions undertaken during product use. In a world where most people think most products are safe, and where they have little ability to distinguish among levels of risk, a warning would simply say: "Be careful, this product contains risks above the norm." Posit as well that the government could precisely determine the risk per use of every product. It would then presumably set an optimal cutoff risk level, r^*, above which a product would have to carry a warning label. The terminology of the warning—that is, whether it says "above the norm," "very dangerous," or whatever—would be calibrated to the group of products receiving the warning. Such designations might be specific to the product class, as, for example, the risk level that is above the norm for drain opener might differ significantly from the risk level for denture adhesive, allowing benefits to be taken into account. For simplicity, we focus on a single warning threshold across all products.

A well-informed public, having had experience with this system, would then know that any product with a warning label carries a risk, say risk per use, at r^* or above. If there was substantial variability in the risk level of products getting a label, individuals might have a hard time, since they would not know whether the product was just at the r^* threshold or perhaps many times as risky.[4]

Just as individuals have limited ability to effectively interpret information about risks, they may have difficulties responding effectively to warnings. First,

Table 13.1. Net benefits from warning

	Stop consuming	*Continue consuming*
Net negative individual	1. B_N (+); m_1	2. W_N (–); m_2
Net positive individual	3. B_P (–); m_3	4. W_P (–); m_4

we identify what the ideal response to a warning would be. Alerted to the potential risk, individuals would first assess their personal level of risk from consuming another unit of the product. That marginal risk level could depend on factors such as their age, health condition, and the amount of the product to be consumed, positing that incremental risk increases with dose. Second, they would quantify their benefits from a marginal unit of consumption. Those for whom the net benefit from another unit of consumption is negative (positive) will stop (continue) consumption.

For simplicity, we shall leave aside secondary considerations, such as reducing consumption, and assume that all individuals would consume one unit of a product absent a warning, and after the warning, each individual would consume either no units or one unit. We define four categories that depend on whether the individual chooses to stop consuming the product as a result of the warning and on whether he or she accrues net benefits from this decision.

Table 13.1 shows the elements of a benefit-cost analysis of a warning. Let *B* be the (possibly negative) net benefits an individual gets from using the product, *W* the loss due to the warning for individuals who continue to consume (and may feel anxious or otherwise discomfited as a result), subscripts *N* and *P* respectively represent net negative and net positive benefit individuals. Let (+) or (–) then show the sign of the payoff for people in each group. Finally, let *m* be the number of people falling in each of the four categories. Thus, $m_1 + m_2$ is the number of net negative individuals, and $m_3 + m_4$ is the number of net positive individuals. To illustrate, an individual in category 3 (B_P (–); m_3) might be an individual who gives up fish completely, despite the presence of beneficial omega-3 fatty acids, because of a warning about mercury in some types of seafood.

To tally the total payoff from the warning, *T*, we simply multiply the payoff in each box by the numbers in each box, and then sum. It is thus,

$$T = B_N{*}m_1 + W_N{*}m_2 + B_P{*}m_3 + W_P{*}m_4. \quad (1)$$

The first term in equation (1) represents the intended response of the warning: individuals with negative net benefits who forego consumption. This represents a positive payoff. The other three terms are negative. Leave aside for the moment the second and fourth terms, say because (as seems plausible) the losses from an ignored warning are small in absolute value relative to the benefits from a properly heeded warning, B_N, or the losses due to an inappropriately heeded warning, B_P. That is, $|W_N| \ll |B_N|$ and $|W_P| \ll |B_P$. Then, the key implication of equation (1) is that a warning will be more worthwhile the greater the fraction of individuals who should stop consuming, the greater the response of such individuals to the warning,[5] and the smaller the fraction of individuals who shouldn't stop consuming who inappropriately do stop in response to the warning.

Warnings come in many flavors, with different intensities. Thus, listing an ingredient on a food label, as with fats or calories, could indicate concern. Text warnings can vary in the extent of the threat they indicate. And rotating threat warnings across packages, as is done with cigarettes in the United States, recognizes that for any particular label there are limits on what people will process, but multiple warnings indicate that consumption brings many dangers. Canada, Australia, and the United Kingdom go further with highly disturbing graphic warnings for cigarettes. Presumably, equation (1) could guide the choice among alternative forms of warning for a product. The warning providing the highest net benefits should be chosen.

For warnings to be efficient, clearly benefit-cost analysis must be brought into play. The key questions involve preferences and elasticities. Under preferences, we must know what benefits and costs are incurred by those who do and do not respond to a warning. The elasticity answer tells us how strongly different groups respond to warnings. We shall illustrate the importance of preferences and elasticities in our analysis of graphic cigarette labels and FDA's trans fat label.

Graphic Cigarette Labels, Preferences and Elasticities

The 1964 U.S. Surgeon General's report on smoking, which indicated that it causes lung cancer, is generally credited as the major milestone in U.S. efforts to decrease cigarette consumption. Since that time, policy interventions have been diverse and numerous, ranging from educational campaigns to

taxes, and involving all levels of government. As a leading cause of preventable deaths, smoking is one of the most well-studied public health problems but also one of the most complex, given the effects of addiction, heterogeneity in preferences, and other factors.[6]

We focus here on federal requirements for placing warning labels on cigarette packages. These labels were first required by law in 1965 to be on cigarette packs in 1966, then subsequently modified to indicate specific health outcomes. The labels in use today were introduced by law in 1989. They include four rotating statements: (1) "SURGEON GENERAL'S WARNING: Smoking Causes Lung Cancer, Heart Disease, Emphysema, and May Complicate Pregnancy"; (2) "SURGEON GENERAL'S WARNING: Quitting Smoking Now Greatly Reduces Serious Risks to Your Health"; (3) "SURGEON GENERAL'S WARNING: Smoking by Pregnant Women May Result in Fetal Injury, Premature Birth, and Low Birth Weight"; and (4) "SURGEON GENERAL'S WARNING: Cigarette Smoke Contains Carbon Monoxide."

More recently, the 2009 Family Smoking Prevention and Tobacco Control Act required FDA to issue regulations mandating the addition of color graphics, along with nine revised text warnings.[7] FDA finalized such regulations in 2011 (Food and Drug Administration 2011). Some of the potential impacts of graphic warnings can be illustrated by returning to our model above. Consider categories 1 and 4 of Table 13.1. When these warnings lead more net negative beneficiaries from smoking to stop or reduce consumption, that is beneficial. However, when the graphic health warnings do not alter such individuals' consumption, their enjoyment from smoking is reduced because of the anxiety or disgust triggered by the warnings; that is detrimental. It is also detrimental if warnings lead to exaggerated risk beliefs, which in turn discourage positive-net-benefit smokers.

Several tobacco companies sued FDA on the basis that the 2011 regulations violated the First Amendment and served no constructive role in informing consumers. FDA argued that the warnings visualized factual information. The companies countered that the graphics were not purely factual—they were designed to provoke an emotional response. The U.S. Court of Appeals for the District of Columbia ruled that the graphic warnings that have been developed thus far did not serve an informational function. In its 2012 decision in *R.J. Reynolds Co. v. Food and Drug Administration*, the Court concluded: "FDA has not provided a shred of evidence—much less the 'substantial evidence' required by the APA [Administrative Procedures

Act]—showing that the graphic warnings will 'directly advance' its interest in reducing the number of Americans who smoke." FDA is now reconsidering the regulations.

How greatly any graphic labels policy might further reduce smoking rates is unclear. Existing policies now have likely dissuaded those who are less interested in smoking. Current smokers may persist because they find that the pleasures of smoking outweigh the costs, or because of erroneous decisions that are difficult to remedy through informational efforts. An appropriate benefit-cost analysis will tally the welfare effects of graphic labels on those who continue smoking, whether they fall into category 2 or category 4.

There is substantial debate about the effectiveness of the types of graphics included in FDA's 2011 proposals, quite apart from their legal standing (Viscusi 2011). Whether graphic warnings are desirable depends on whether, given the actual risks posed by cigarettes, the benefits associated with leading net negative smokers to stop smoking and nonsmokers to never start smoking outweigh the costs from requiring continuing smokers to view gruesome images.

Trans Fat in Food: Industry Responds to Consumer Warnings

Under the Federal Food, Drug, and Cosmetic Act, FDA can require certain types of food labeling to aid consumers in maintaining healthy diets. After many years of consideration, FDA issued regulations in 2003 requiring that nutrition labels indicate the amount of trans-fatty acids present in foods and dietary supplements (Food and Drug Administration 2003). The regulation was followed by local bans that also addressed restaurant food, as well as court cases targeting particular companies (Unnevehr and Jagmanaite 2008).[8]

Though fats are just listed on the nutritional labels for foodstuffs, alongside beneficial nutrients such as protein, most consumers do know that they are considered a bad element as a result of the accompanying informational campaigns. However, few individuals know much about the levels and characteristics of risks associated with different quantities of each type of fat, or even what levels are high or low. Thus, unlike other information required by the government, such as calories or miles per gallon for autos, merely having fat content on a nutritional label serves as an undifferentiated warning for most people who note that information. Informational content works just like a warning when individuals know that an ingredient or feature carries risk,

but they have little ability to process the information beyond seeing that a risk is present.

The 2003 regulation, which became effective in 2006, requires that manufacturers add a separate line to the nutrition label that indicates the grams of trans fat, following the "saturated fat" listing under the "total fat" heading. While the label includes a percent of daily value for total fats and for saturated fats, no percentage is provided for trans fats. These daily values indicate the amount of each nutrient that should be consumed as part of a healthy diet. However, FDA stated that it lacked the data needed to develop such a daily value for trans fat. Products containing less than 0.5 grams per serving can list trans fat content as zero. If the amount reported is zero, manufacturers can also declare the absence of trans fat on the front of the package. FDA provides some exemptions to this labeling requirement, generally for products that report zero grams of trans fat and do not make claims about their low fat, fatty acid, or cholesterol content.

On its own, listing trans fat on the label provides information, not a warning. After all, nutrition labels list both healthful and unhealthful ingredients. What gives it warning status is the associated information dissemination efforts (by FDA, public interest groups, and others) on the dangers of trans fat consumption. The effectiveness of the labeling is thus dependent on individuals' awareness and understanding of the risk information provided, as well as their attentiveness to the reported trans fat content.

Trans fats are associated with increased risk of coronary heart disease, as well as possibly other health conditions such as diabetes and some cancers. They bring benefits as an inexpensive approach to increasing shelf-life and improving taste and texture, particularly in pastries, margarine, and snacks such as cookies, crackers, and chips. Reformulation to remove them is generally technically feasible and may involve the substitution of saturated fats in some cases. While saturated fats bring health risks, they are believed to be well below the risks brought by trans fats.

Many analyses of warnings take the risk environment as given and consider only responses by consumers. However, producers may also respond when a warning about risk is provided for their product. First, a government information effort may lead them to recognize that a risk is much greater than they thought. Second, producers may have been aware of the risk level, but have been capitalizing on consumer ignorance. Once the information is made available in the market, the jig is up. Third, they may feel that potential litigation over risk imposition has become more likely.

We will focus on a fourth factor: Once producers can get credit for a lower risk product, competitive considerations may make risk reduction worthwhile. Equation (1), in essence, revolved around the elasticity of demand in response to a warning for net negative and net positive individuals. Let's say that after a warning, sales would be 15% higher if a risk were reduced sufficiently to avoid the warning. If avoiding risk is costly, it may not be worthwhile to avoid risk if it would merely boost demand by 15%. A monopolist would think in such terms. But in a market where there was reasonable competition, hence meaningful cross-elasticity of demand, avoiding the warning would be much more consequential to a producer. If other producers kept to their risk levels, the risk-avoiding producer might gain sales of, say, 40%. If most others did reduce, a producer who did not might experience a 60% drop. Of course, the producers are in a form of prisoners' dilemma. If all reduce, they will be back to roughly prewarning market shares, but with a more costly but lower risk product.

Indeed, the trans fat case suggests that observed elasticities of consumption can be due more to producer than to consumer actions. In its economic analysis of the 2003 regulation, FDA conservatively estimated the resulting health benefits, underestimating these effects. It assumed that consumers would choose to decrease their intake by 0.1% and that manufacturers would decrease the trans fat content of margarine by 10% (in addition to margarine reformulation already underway). Using these conservative assumptions, FDA estimated that the labeling requirement would prevent 600 to 1,200 cases of coronary heart disease and 240 to 480 deaths per year, thus providing benefits with a present value of $13 billion to $27 billion over 20 years, compared to costs of $139 million to $275 million (3% discount rate, dollar year not reported). In addition to underestimating the health-related benefits, FDA likely underestimated the negative consequences, although intuition suggests that these costs may be relatively small. The cost estimates focused on the one-time effects of reformulation; the longer term impacts on prices and on supply and demand conditions more generally were not quantified. Nor did FDA quantify the value consumers would place on averting changes in product attributes such as taste and texture. Although FDA believed that reformulation of other products was likely, it lacked the evidence needed to quantify the effects on trans fat intake.

Subsequent research suggests that reformulation was substantial (e.g., Unnevehr and Jagmanaite 2008; Mozaffarian, Jacobson, and Greenstein 2010;

Rahkovsky, Martinez, and Kuchler 2012; Van Camp, Hooker, and Lin 2012). However, it is unclear how much credit goes to the labeling requirements as opposed to the increasing evidence on risk, court cases, local bans, and associated publicity. FDA estimates that between 2003 and 2012, consumption of trans fat decreased by about 78% (Food and Drug Administration 2015). How much of the reduced consumption is attributable to consumer behavior rather than producer decisions is uncertain. For example, one study (Howlett, Burton, and Kozup 2008) suggests that high-risk populations may be confused about the importance of limiting trans fat consumption.

The producer response likely reflects the economic calculus discussed above: producers could cost-effectively reduce trans fat levels without significantly hurting their net revenues or market share. "No trans fat" claims on the front of the package might even increase net revenues. While the producer response limited consumer choice, it is unclear how much consumers valued the advantages conferred by trans fats. A complete benefit-cost analysis would start by assessing individual preferences for both the benefits and harms associated with consuming trans fats.

More information is required before we can make a definitive assessment of the desirability of graphic warnings on cigarette packages or of FDA's dictates on trans fats.

"Wolf or Puppy" Warnings

Every child knows the tale of crying wolf: raising an alarm often when there really is no wolf leads the population to complaisance; it thus ignores the legitimate cry of wolf. This problem hardly afflicts the warning system in most nations.[9] However, a different problem afflicts many such systems. They impose the same warnings on many little dangers that they do on big dangers. Wolves are a dangerous wild animal. When they are about, they deserve a warning. Puppies too could bite you. However, a system that sounded the same alarm—say "Wolf or Puppy About"—when either a wolf or a puppy was in the vicinity would be of little value. People would quickly learn to ignore the warning, since puppies are many times more common than wolves, and represent very little danger. We shall argue that a wolf or puppy warning system provides an apt metaphor for many existing warning systems, where large numbers of products, some imposing very modest dangers and others

great dangers, get the same warning labels. In similar fashion, overinclusive warnings by an overcautious parent may induce a child to take more, not fewer, serious risks.

The potential for cancer, which generally heads the public's list of dread diseases, is often the concern for such labels, as it is with California's Proposition 65, discussed below. More than 800 different chemicals were on the list as of 2018. The risks created by exposure to these chemicals differ by orders of magnitude. Not surprisingly, individuals homogenize abundant warnings, and often fail to respond to the small minority that impose grave risks. In a quite different context, companies launching initial public offerings and responding to strictures of the U.S. Securities and Exchange Commission list large numbers of risk factors, making it virtually impossible for investors to discern what the major risks are or how significant overall rates may be.

Mercury in Seafood: Confused Responses to Competing Messages

In 2001, FDA issued an advisory targeted on women who are pregnant and others of childbearing age that encouraged them to avoid eating fish containing potentially high levels of mercury (particularly shark, swordfish, king mackerel, and tilefish), while noting that seafood (here used interchangeably with fish) is an important part of their diet. In 2004, FDA and EPA issued an updated advisory that included similar warnings but placed a greater emphasis on the beneficial impact of overall fish consumption on health.[10] These competing messages were worse than the mixing of puppies and wolves on warnings. Beneficial seafood got confused with detrimental seafood. After substantial study, the agencies eventually issued a new advisory in 2017 that attempts to correct this problem.

Mercury is a neurotoxin associated with developmental delays in young and unborn children, typically measured as reductions in IQ. At the same time, seafood is an important source of healthful omega-3 fatty acids, which may reduce the risk of heart disease and stroke, while also benefiting the neurological development of the young and unborn. The policy goal in this case is to encourage vulnerable individuals to reduce their consumption of those fish species that are high in mercury, while increasing the general population's overall consumption of other seafood types.[11]

The net health benefits of these advisories are likely to be positive if consumers comply with them as intended; however, the available evidence sug-

gests that historically the advisories may have instead led to decreases in overall seafood consumption and health-related losses. The complexity of the messages appears to lead to confusion and misinterpretation, with overattention to potential losses in comparison to potential gains.

For example, Cohen et al. (2005) consider the risk-risk tradeoffs associated with three scenarios. Their "optimistic" scenario assumes women of childbearing age follow the advisory, shifting consumption from high to low mercury seafood. Their "middle" scenario assumes that only women of childbearing age respond to the advisory, but they reduce their overall consumption of seafood rather than changing the mix of seafood consumed. Their "pessimistic" scenario assumes that all members of the population reduce their seafood consumption, rather than solely those targeted by the advisory.[12] Not surprisingly, Cohen et al. (2005) find that following the advisory under the optimistic scenario leads to a large net gain in health. If women of childbearing age reduce all seafood consumption under the middle scenario, the gain is smaller. Under the pessimistic scenario, if the full population reduces their consumption, the health losses are significant.[13] The researchers also consider the health gains associated with increasing, rather than decreasing, seafood consumption and find that they are substantial.

Shimshack and Ward (2010) explore the effects of the January 2001 FDA advisory using scanner data on seafood purchases. They find that the at-risk group reduced their intake of both mercury and omega-3 fatty acids due to a decline in all seafood consumption. Using standard monetary values for lost IQ points and mortality from EPA analyses, the authors estimate that the value of the associated health losses was about $30 per household. They also estimate the gains that would accrue if these households had instead behaved in accordance with Cohen et al.'s (2005) "optimistic" scenario, finding benefits of $587 per at-risk household. Rheinberger and Hammitt (2014) extend this analysis and consider the welfare losses in a dynamic framework. They find that accounting for longer term effects may substantially increase the losses associated with unintended responses to the policy.

In 2017, after substantial study, FDA and EPA issued a new advisory. It provides an easy-to-read, concise chart listing what types of fish should and should not be consumed by women of childbearing age and young children, including specifying the acceptable number of servings and portion sizes. We hope that future research will find that this innovation reduces inappropriate responses without significantly curtailing appropriate ones. The goal is to avoid conflicting or competing messages, thus enabling individuals to be

better able to calculate their net benefits, and thereby place themselves in the correct category in Table 13.1.

California Proposition 65—A True "Wolf or Puppy" Warning System

A ballot referendum led to the enactment of California Proposition 65, which is the Safe Drinking Water and Toxic Enforcement Act of 1986. The Proposition's main focus was to establish warning requirements for carcinogens and reproductive toxicants. However, it was confusingly described, and few voters expressed awareness of the warning provisions. Most simply thought that its goal was to protect water supplies/keep them clean, to control toxic chemicals and where they are dumped, to bring toxins under control, and more generally, to protect the environment (Field 1986).

Product warnings have two possible general functions: (1) to influence the discrete decision of whether to use the product, and (2) to influence the manner in which the product is used by, for example, altering precautionary behavior. Proposition 65 warnings are of the first type; they are designed primarily to alert consumers to carcinogens and reproductive toxicants. They do not, for example, indicate how much of a product a person should consume or whether it can be consumed with other products. Even within the narrowly defined objective of informing the discrete product use decision, Proposition 65 warnings flunked the test of providing accurate or useful information to consumers. Only recently has the State of California begun to address the problems that it created.

The risk levels that trigger these warnings historically have been quite low. In the case of carcinogens, the safe harbor risk level below which no warning is required is an exposure that leads to a risk below a lifetime probability of 1/100,000 of incurring a cancer based on a 70-year lifetime of exposure (OEHHA 2013). By way of comparison, the cancer risk of smoking is over 10,000 times greater than this risk level. The safe harbor risk level for reproductive toxicants is a no observable effects standard. This safe harbor value is the amount of exposure for which 1,000 times that exposure has no observable effects on the growth of the fetus, whether these effects are beneficial or adverse.

Until recently, the example of acceptable on-product wording for carcinogens was: "WARNING: This product contains a chemical known to the state of California to cause cancer." The counterpart wording for reproductive

toxicants was: "WARNING: This product contains a chemical known to the state of California to cause birth defects or other reproductive harms."

Do such warnings provide accurate information, or do they exemplify the "Wolf or Puppy" warnings discussed above? Survey data on how adult consumers view this warning are instructive (Viscusi 1988). Because the survey testing the warnings language was run in Illinois, the wording of the warning was identical to that for California except that the name of the state was changed. Suppose that the warning language appeared on a consumer product such as breakfast cereal. Most consumers viewed a Proposition 65 warning on cereal as conveying a risk comparable to that of cigarettes. Overall, 69% of consumers believed that the Proposition warning was about a risk equal to that implied by the 1966 cigarette warning ("Caution: Use of this product may be hazardous to your health"), and 48% believed that it was comparable to a variant of the 1969 cigarette warning ("Warning: The state of Illinois has determined that this product is dangerous to your health"). The remaining respondents divided between thinking that the Proposition 65 wording was weaker or stronger than that for cigarettes.

The respondents also considered a linear risk scale and rated the product relative to three different risk anchors. A minority of the sample, 21%, rated a product bearing a Proposition 65 warning as being between zero and the risk of one 12-ounce saccharin cola, 44% rated the risk as being between that of a saccharin cola and a pack of cigarettes, and 35% rated the risk as being between one pack of cigarettes and five packs of cigarettes. Taking cigarettes as the benchmark for wolves, the Proposition 65 warnings are largely about puppies.

Perhaps in part because of the stringency of the warnings language, companies sought to reformulate numerous products so as to avoid the labels. At the time of its implementation, California had about one-eighth of the national market share for grocery products. Among the products that were found requiring warnings were Liquid Paper (correction fluid) and some types of power cables. Liquid Paper was reformulated; the power cords are now labeled.

Warnings for products are not ubiquitous in California because many risks have been exempted from the requirements. These special exceptions carved out in the implementation of Proposition 65 also tend to undermine its usefulness even from the standpoint of "warning wolf" on a consistent basis. In deference to California's agricultural industry, natural carcinogens that are present in food or occur as part of the handling and shipping of the

product are exempt from the carcinogen calculations. Thus, carcinogens in peanuts such as aflatoxins are exempt from the lifetime risk threshold. The absence of a warning consequently doesn't necessarily imply that the product poses less cancer risk than does a product for which a warning is required. It would also be potentially deleterious to the California wine industry to have wine from California bear a warning of carcinogenicity and reproductive toxicity that goes beyond what is required nationally.[14] As a result, there is no California requirement for on-product warnings for alcohol, only a placard in the store with a warning such as the following: "WARNING: Drinking distilled spirits, beer, coolers, wine and other alcoholic beverages may increase cancer risk, and, during pregnancy, can cause birth defects" (OEHHA n.d.). There are similar postings in restaurants. There are also postings for environmental exposures at locales such as gasoline stations.

Potatoes have received one of the more bizarre Proposition 65 warnings. When potatoes are fried or baked, not boiled, acrylamide is formed. Because acrylamide is listed by the state of California as both a carcinogen and a reproductive toxicant, the warnings requirement is triggered. Customers at McDonald's would see a posting noting that acrylamide is not added to the potatoes by McDonald's but is present after cooking, and is also present at lower levels once hamburger buns are browned. This warning also appears on products such as potato chips. The behavioral guidance implied by the warning is murky at best, since consumers who seek to avoid the risk by baking potatoes at home will create similar risks, though without any attendant warning. Similarly, the acrylamide that is produced when coffee beans are roasted leads to a Proposition 65 warning at Starbucks and its competitors.

The Proposition 65 experience imparts three principal lessons. First, stamping any product as hazardous will lead consumers to put it in the same class as other mass-marketed products meriting such warnings, such as cigarettes, if their attention is drawn to the warnings. However, if such warnings proliferate, their sheer abundance may lead to their being ignored. Second, the decision to require a warning and the wording of the warning should be designed in a manner that will lead consumers to at least roughly assess the accurate risk level. Using cigarette warning language is seldom desirable because cigarettes are so much more dangerous. Third, warnings should be designed to enable people to make sensible decisions regarding whether to use the product and, if so, what precautions to take.

The state of California has begun to address some of these concerns. For example, as of August 2018 the warnings have been changed to provide more information on the chemical present and the associated risks (OEHAA 2018a). California is also now proposing to remove the warnings requirement for coffee (OEHAA 2018b). However, these changes do not seem to address key issues. For example, rather than better tailoring the warning to the level and type of risk, the new requirements may heighten fear by adding a yellow triangular warning symbol containing an exclamation point. Consumers are directed to a website for more information. Accessing this information, understanding the implications, balancing the risks with the benefits of consumption, and comparing risks and benefits across products is likely to require substantially more time than most are willing to spend on such tasks. Those who take the time to review the information will likely find it to be burdensome. The initiatives also do little to restrain the number of products requiring warnings. Providing warnings that fail to discriminate among risks of differing magnitudes neither fosters efficient risk decisions by consumers nor provides the basis for effective risk-averting behaviors.

Conclusion

The success of informational policies, and their preservation of individual choice, has created substantial support for warnings policies over the past several decades. Our increased understanding of the importance of behavioral factors has provided additional impetus to the adoption of informational approaches. The legitimate economic objective of warnings is to provide accurate information that will assist people—particularly those experiencing high consequences—in making better informed decisions. The principal policy objective should be to lead more people to make correct choices. Based on the true probabilities, ideally we want people for whom the net benefits are positive to consume the product and those for whom the net benefits are negative to avoid or curtail consumption. The benefit-cost calculation for a warning thus has to attend to elasticities of response by the two groups, and their benefits from stopping or continuing consumption.

Many warnings policies, alas, are of a grab bag variety, a feature exemplified by California's Proposition 65. Warnings policies should recognize that wolves are not puppies and that seafoods are not cigarettes. Regulations

that are dramatically misplaced tend to undermine the legitimacy of well-targeted regulations.

As we look forward, what is the future of risk and what is the future of warnings, the two being closely entwined? There are many possible strands to the answer. We provide four: warnings proliferation, weaknesses of extant warning systems, the heightened role of intended harms, and newly emerging dangers.

This analysis took an implicit benefit-cost approach to warnings for specific products. It introduced the notion that for individuals who consume despite receiving warnings, the warning will impose a cost: the consumption will be less attractive. Society has been on a warnings spree for the past few decades. Legislatures and agencies do not like to give up their right to warn, in part because on the surface it appears to be a low-cost approach to dealing with the difficult challenges associated with addressing many risks. Thus, there is no letup in sight, much less any curtailment. And there is no check to restrict the emergence of warnings that may serve to divert attention from warnings for more significant hazards. Given this vast proliferation, it is also important to extend cost-benefit considerations across products. It is reasonable to speculate that each additional warning makes individuals less likely to attend to prior warnings. Think of the mother who gives her child a hundred warnings, from "look both ways before you cross the street" to "never play in puddles." The puddle warning, though possibly avoiding exacerbating cold symptoms and the discomfort and hassles of wet clothing, may prove an expected net negative for health and safety if the street-crossing warning gets slightly less attention. So it is with prospectuses for financial investments, where the listing of a few dozen risk factors makes it hard to know which, if any, are important. Our warnings makers must beware of even a weak Cassandra effect. Cassandra issued many prophecies on future dangers, all proved true, but virtually all were ignored.

Psychologists and economists—the major contributors to this volume—have become strange bedfellows in the march toward more warnings, one variant of nudges. Unfortunately, there has been virtually no progress in developing systems that readily differentiate big from little dangers in ways that can effectively inform citizens. Thus, a product imposing some carcinogenic risk, once identified, unless prohibited, secures a warning that proves equivalent for virtually all consumers whether it imposes a 1-in-a-million risk or 1 in 10. The undifferentiated warning problem exists, even when numerical scoring is possible. The Doomsday Clock of the Bulletin of the Atomic Scientists,

which indicates the likelihood of global catastrophe, has never moved further than 10 minutes before midnight since 1998. Groups that issue warnings are hesitant to ever state that risks are only moderate, much less minimal. In time, none believe those who continuously cry wolf. Recognizing that our future is one of widespread warnings, significant research is needed on how to make critical warnings more salient than others.

Since the 9/11 calamity, most individuals have felt greater threats from intended harms, notably terrorism, than from mere collateral risks of everyday life, such as dying in an auto accident. That is true even though auto accidents kill many more Americans every year than have been killed by terrorists throughout history. The U.S. Department of Homeland Security (DHS) used to have a color-coded warning system, based on the successful system for forest fires. However, it is far more difficult to assess terrorism risks than forest fire risks. The absence of base rates, the ability of terrorists to adapt to any new protective measures, and the distinctive nature of different terrorist attacks foil predictive methods. It is also hardly clear what benefits warnings would have. It is almost impossible to stay out of vulnerable locales, and political leaders usually tell us to go about our business; otherwise the terrorists have won. DHS ultimately gave up its color-coded warning system and replaced it with more informative advisories.

Some massive emerging risks are clear; others remain cloudy. Both are stimulating the activities of various warnings masters. Climate change is the clearest future risk. The strong scientific consensus is that climate change is real, man-made, and will be highly consequential. Most warnings about it are intended to get societies to do more to control greenhouse gases, though the consensus is also strong that it is probably too late to avoid significant temperature increases and associated climate change. The ability of governments to get together to provide a public good for the world at large is also in question. Perhaps the warning should be that climate change warnings will mostly be ignored.

Emerging technologies are also ringing alarm bells in important quarters. Prominent sources of concern today are gene therapy, artificial intelligence, and solar geoengineering to prevent climate change. Revolutionary technologies almost always raise such concerns. Warnings tend to slow but rarely stop their progress. The warnings, which invariably come from selective quarters, have almost always turned out to be excessive in the past. And should a doomsday technology ever come into being, warnings will have proved to be insufficient. Revolutionary technologies often bring puppy

dangers alongside their benefits. At times, they impose wolf dangers. Let's hope our warnings are sufficient when their dangers are dragons.

The major challenge to our densely populated nonsystem of warnings is to find ways to separate puppies from wolves from dragons.

Notes

1. Adler and Pittle (1984) provide such a skeptical view of warnings, which is noteworthy since David Pittle was a commissioner of the Consumer Product Safety Administration.

2. For a review of these policies and economic and behavioral principles for warnings, see Viscusi and Magat (1987); Magat and Viscusi (1992); American Law Institute (1991); Viscusi and Zeckhauser (1996).

3. See Thaler and Sunstein (2008) for articulation of the rationales for "nudge" policies. The information disclosure aspects of this approach were incorporated into U.S. policy in Sunstein (2011).

4. Informing the public about the average risk of labeled products receiving warnings would still suffer the problem of applying the identical label to products representing dramatically different risk levels.

5. This conclusion assumes, as seems plausible, that enough individuals who should stop consuming do stop to make the warning worthwhile for this group alone.

6. See, for example, U.S. Department of Health and Human Services (2014); Jin et al. (2015); Cutler et al. (2015) for more discussion.

7. Sunstein (2014) discusses such warnings from the perspective of "nudge" policies.

8. In 2015, FDA determined that partially hydrogenated oils (the primary dietary source of industrially produced trans fats) are not generally recognized as safe for use in food, effectively banning them.

9. Of course, there are independent organizations that issue warnings about products (or individuals) that pose little or no threat, often for self-serving or political purposes. Our focus is on government operated, imposed, or induced warning systems.

10. More information on these advisories and their evolution is available at https://www.fda.gov/Food/ResourcesForYou/Consumers/ucm393070.htm and https://www.epa.gov/fish-tech/2017-epa-fda-advice-about-eating-fish-and-shellfish

11. For a broader discussion of the risks and benefits of fish consumption, see Oken et al. (2012).

12. The reduction in fish consumption assumed under the middle and pessimistic scenario was 17%, based on previous research on the effects of the 2001 advisory (Oken et al. 2003), which did not discriminate between high and low mercury fish.

13. The findings are aggregated using quality-adjusted life years (QALYs); the optimistic scenario leads to a gain of 49,000 QALYs, the middle scenario leads to a gain of 9,700 QALYs, and the pessimistic scenario leads to a net loss of 41,000 QALYs.

14. The federally required warning reads: "GOVERNMENT WARNING: (1) According to the Surgeon General, women should not drink alcoholic beverages during pregnancy because of the risk of birth defects. (2) Consumption of alcoholic beverages impairs your ability to drive a car or operate machinery, and may cause health problems."

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