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Hazard Communication: Warnings and Risk

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ABSTRACT: Risk information can alter risk judgments and promote sound risk decisions. Hazard warnings are critical in providing such information. Both right-to-know and duty-to-warn obligations reflect this. Evidence suggests that warnings can significantly affect risk-taking decisions, but care is needed in interpreting whether their influence leads to successful outcomes. Hazard warnings must accommodate individuals' cognitive limitations. Salient problems include recipients who suffer information overload or are unable to grasp adequately the level of risk communicated.

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SITUATIONS involving risk often are coupled with shortcomings in information. Workers may not know the risk of being killed on the job. Consumers may be unaware of the hazards posed by prescription drugs, and society at large may not have the best available information on the risks of nuclear accidents. Information has the potential to promote more informed choices.

In legal contexts, the potential role of information is recognized in the duty to warn. Firms marketing hazardous products, for example, must apprise consumers of the risks associated with these products. The public's right to know risk levels has received considerable attention in regulatory contexts.

Figure 1 portrays the potential role of risk information about a potentially unsafe product. Information affects individuals' risk assessments, which in turn affect the product's expected utility benefits. The product may be employed in situations with pertinent safety precautions taken or not. Individuals must decide whether or not to use the product and, if so, whether to take precautions. In any event, the consumer will have an experience with the product, possibly leading to an injury. Such experiences will alter the consumer's risk beliefs and thereby affect future purchases of this and other products.

Hazard warnings and related types of information provision can ameliorate risk information shortcomings. People often have different preferences with respect to risk and injury, and hazard warnings facilitate decentralized risk-taking decisions, which can readily reflect such heterogeneous preferences. Hazard warnings can also be instrumental when we wish to encourage particular types of unmonitorable behavior, such as taking precautions when using household pesticides. Risk information programs increase individuals' perceived risks associated with dangerous products and activities, thereby indirectly creating market incentives for safer products.

Hazard warnings often represent an attractive intermediate policy option between a ban and doing nothing. Policymakers may have some knowledge of the risk, but insufficient grounds for taking strong action, such as a ban, against a hazard. Until the magnitude of the risk is better defined, it may be useful to employ hazard warnings to alert people to a potential risk, thereby enabling them to exercise appropriate care.

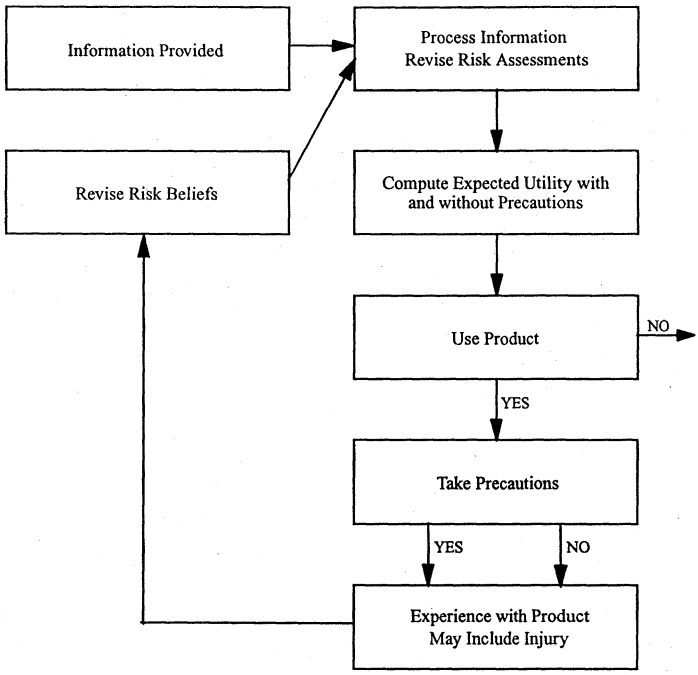
Communicating risks effectively is a challenge. Individuals have an incredibly difficult time making sound decisions under conditions of uncertainty;[1] this difficulty limits the efficacy of warnings in promoting accurate risk perceptions and fostering rational decisions. This article explores some of the principal characteristics of hazard warnings and the ways they can be designed to best promote appropriate levels of safety.

WARNING STRUCTURE AND CONTENT

If individuals had perfect and unlimited information-processing capa-

1. A range of difficulties that people encounter is outlined in Daniel Kahneman, Paul Slovic, and Amos Tversky, eds., *Judgment Under Uncertainty: Heuristics and Biases* (New York: Cambridge University Press, 1982).

FIGURE 1
INFORMATION PROCESSING AND ECONOMIC BEHAVIOR



bilities, the informational task would be simple. For pharmaceutical product risks, for example, we could refer consumers to the appropriate medical literature and let them make their own judgments. The example is fanciful: specialized scientific and technical knowledge is required to interpret risk information. Moreover, people have limited ability to process all the diverse information they might receive about a great range of products and activities.

The specific language of warnings often plays an important role. Some potent words, such as "danger," "caution," and "poison," have well-defined meanings within the context of the hazard warnings vocabulary; they imply a certain risk level. For such words to retain their meaning, they should be used consistently across products and contexts. Overwarning and the overuse of such words may, for example, dilute their importance. If every product in the supermarket carries a hazard warning, no distinctions will be made. The proliferation of warnings creates a problem of information overload.

Typically, people can process reliably five to seven pieces of information; attempts to convey more information than that in a hazard warning may confuse consumers and distract them from the central message of the

warning.[2] For example, warnings on some commonly marketed insecticides provide overly detailed information about how the product might be used on particular plants and about particular hazards. The net effect is that consumers are better able to make proper decisions with respect to the safe use of the product when presented with a warning that focuses on only the more important risks.[3]

The format of a warning can affect how well consumers process the information contained. Well-organized information printed in one place on the label can be read more readily than information that is dispersed. Similarly, warnings that follow a consistent organization for all products, such as the hazard warnings on pharmaceutical products, can be more easily processed. Consumers know where to find warning information about uses, adverse reactions, and the like, and this information is printed in a standardized format and written using a standardized vocabulary.[4]

2. For discussion of the limitations on human information processing, see W. Kip Viscusi and Wesley A. Magat, *Learning About Risk* (Cambridge, MA: Harvard University Press, 1987).

3. As another example, a study of consumer responses to household chemicals found that a cluttered warning actually led to increased likely riskiness of the product during use. Consumers did not accurately process product usage information if too much was provided. See Wesley A. Magat and W. Kip Viscusi, *Informational Approaches to Regulation* (Cambridge: MIT Press, 1992).

4. The importance of a standardized warning vocabulary has been recognized in legal contexts by the American Law Institute. See American Law Institute, *Enterprise Responsibility for Personal Injury: Reporters' Study* (Philadelphia: American Law Institute, 1991).

In addition to hazard warnings, risk information can be communicated through videos, educational advertising in the media, and risk training programs, among other mechanisms. It is particularly helpful to use a variety of avenues to convey complex messages. For example, the Environmental Protection Agency requires that users of very hazardous pesticides become certified pesticide applicators, for which they must undergo safety training. Consequently, the test for whether the risk information is communicated effectively does not rest on the effectiveness of only the on-product warning but, instead, examines the entire hazard communication system.

The warning context helps to define the audience for the warning. Is the recipient of the warning a sophisticated user, such as a physician or an industrial chemist? The warnings appropriate to the general consumer do not presuppose the expertise of an informed recipient. The source of the warning information is also important, particularly that source's credibility. Large companies, for example, have a strong incentive for integrity. It will help them avert unfavorable liability judgments and maintain future credibility. An information provider who develops a reputation for being systematically alarmist or complacent will find his credibility jeopardized.

The objective of a warning should not be to inspire the most cautious response possible but to enable consumers to form accurate judgments of the risk level and take appropriate action. Overwarning introduces dangers. If we exaggerate modest risks,

we will have no credible mechanism for alerting people to greater hazards.

A continuing problem is how to communicate risks when there is conflicting scientific evidence, particularly since this implies that information will evolve. If we alert people to a risk now and it turns out later that there never was any risk, we could be labeled as crying wolf. At the same time, if there probably is a hazard, we do not want to be remiss in alerting people. The imprecision in our risk judgments should not lead us to undue complacency, nor should it spur us to focus on the worst-case scenario.

INFORMATION PROCESSING AND RISK PERCEPTIONS

Before warnings can have an effect, they must be received and processed by the intended recipient. Sometimes the audience for a warning is not the consumer but an intermediary, such as a physician. In these cases, the responsibility for using the risk information may be shared; the physician dispensing pharmaceuticals relies upon the risk information from the manufacturer to make the appropriate prescription and, along with the patient's package insert, alerts the consumer to the potential risks associated with the product.

In practice, warning information is hardly universally received. Heimbach, for example, found that only one-fourth of all consumers could recall the sodium content listing on food labels.[5] In addition, only 40 percent of the sample recalled having read an ingredient list on a food product. More recent food information efforts may reach consumers more successfully. Information on the fiber content of cereals has had a strong effect on cereal consumption patterns.[6]

In the pharmaceutical context, however, one study suggested that many consumers do not bother to read the warning information inserted in prescription drug packages.[7] Overall, just under three-fourths of all subjects claimed to have read the leaflets; moreover, the respondents had volunteered to participate in the study, and they were told that they would be called about the information they received, both factors that would boost readership. Similarly, while 88 percent of oral contraceptive users claim to have read the patient package insert, only 69 percent could recall any information on drug usage, and only 50 percent could recall information about common drug reactions.[8] One study suggests that only one-fourth of all consumers are aware of the Reye's syndrome warnings on aspirin, and just 53 percent are aware that flu patients should not take aspirin.[9]

5. James T. Heimbach, *The Public Responds to Labeling of the Sodium Content of Foods* (Washington, DC: Food and Drug Administration, 1991).

6. Pauline M. Ippolito and Alan D. Mathios, "Information, Advertising and Health Choices: A Study of the Cereal Market," *Rand Journal of Economics*, 21:459-556 (1990).

7. See David Kanouse et al., "Informing Patients About Drugs" (Report R2800-FDA, RAND Corporation, 1981).

8. See Louis A. Morris, Michael B. Mazis, and Evelyn Gordon, "A Survey of the Effects of Oral Contraceptive Patient Information," *Journal of the American Medical Association*, 232:2504-8 (1977).

9. See Louis A. Morris and Ronald Klimburg, "A Survey of Aspirin Use and Reye's Syndrome Awareness Among Parents," *American Journal of Public Health*, 76:1422-24 (1986).

Perhaps the most successful warning effort in reaching consumers has been that for cigarettes. Surveys indicate that between 99 and 100 percent of all individuals have heard that "cigarette smoking is dangerous to a person's health" and similar admonitions.[10]

Just because a person receives information does not mean that the warning was understood. Many consumers have trouble understanding the terms used on food labels, whether the terms are bloated prose, such as "polyunsaturated fat" and "hydrogenated," or more common, such as "carbohydrates."[11] Similarly, consumers confuse salt and sodium. Warnings must be sufficiently salient and readable so that consumers will invest the time and effort to understand the information contained.

If the warning is received and processed, it will alter the consumer's risk assessments. Conveying information that will lead to appropriate risk perceptions is not a trivial task; it is too easy to encourage undue complacency or create excessive alarm. If warnings could convey quantitative risk information—say, "use of this product poses a 1/10,000 risk of an allergic reaction"—then the task would be simplified. However, people often cannot process and act on quantitative risk information in a reliable manner. Indeed, explicit quantitative information plays a prominent role only in pharmaceutical warnings, which are written for physicians, most of whom have substantial training in pharmacology. Rather than telling people the explicit probabilities involved, warnings typically use qualitative mechanisms to alert people to risk.

Evidence suggests that warnings on cigarette packaging and advertising have altered consumers' risk perceptions, though they may not have fostered pinpoint accuracy in these beliefs. In 1949, before the advent of cigarette warnings, 52 percent of all cigarette smokers believed that smoking was harmful; by 1981, 16 years after warning labels became mandatory, 80 percent of all smokers believed that smoking was harmful. Among nonsmokers, the percentage who believed that smoking was harmful increased from 66 percent to 96 percent over the same period.[12]

People seem to think that smoking is riskier than it is, however. Whereas the lifetime lung cancer mortality risk to smokers is estimated by scientists to be in the range of 6-13 percent, individuals assess this risk at 38-43 percent.[13] Overall, smoking mortality risk perceptions also appear to be exaggerated, although the discrepancy is less than that for lung cancer. Perhaps these risks are overestimated because of the substantial public attention given to smoking; however, it is unlikely that close-to-accurate risk beliefs can ever be achieved. The task for informational policies is to help consumers develop risk perceptions

10. See W. Kip Viscusi, *Smoking: Making the Risky Decision* (New York: Oxford University Press, 1992).

11. James T. Heimbach, *The Public Understanding of Food Label Information* (Washington, DC: Food and Drug Administration, 1981).

12. These statistics are based on Gallup poll results reported in Viscusi, *Smoking*, p. 50.

13. See Viscusi, *Smoking*, chap. 4, for discussion of the different smoking survey questions and the responses.

that lie within reasonable ranges, recognizing that because of the diversity of individual responses to risk and the qualitative nature of warnings, risk perceptions will seldom be highly refined.

The relatively large risks posed by cigarettes may make them comparatively easy products for crafting effective warnings. In contrast, very low-probability events—several orders of magnitude smaller than those posed by cigarettes—are more typical hazards. The state of California, for example, has attempted to warn consumers about low-probability cancer risks associated with food products. The draft warning under California Proposition 65 is, "WARNING: The state of California has determined that this product is dangerous to your health."[14] This warning pertains to risks that pose a total cancer risk of at least one in 100,000 over a 70-year lifetime. Survey respondents who assessed the implications of this warning believed that the risk was comparable to smoking 0.58 packs of cigarettes per day, which produces a lifetime risk in excess of one in 10. Many companies reformulated their products rather than have such strident language deter consumers from using the product.

Those designing warning systems face a continuing difficulty in deciding what level of risk merits warning attention. As we provide warnings about increasingly tiny hazards, we make it harder for consumers to notice warnings about the truly consequential ones. Moreover, warning practices patterned on cigarettes and other higher-level risks may be quite inappropriate for extremely low-probability events. On the other hand, we do not wish to ignore small probabilities; they often pertain to the risks that are least well understood by individuals, so warning information can be very helpful.

14. For discussion of California Proposition 65 as well as the empirical evidence regarding risk perceptions pertaining to it, see W. Kip Viscusi, *Product Risk Labeling: A Federal Responsibility* (Washington, DC: American Enterprise Institute, 1993).

THE BEHAVIORAL RESPONSE

Warnings typically encourage two types of response. Those that alert individuals to the inherent risks of a product or activity encourage consumers not to make the purchase or not to participate in the activity. Warnings that advise individuals to take precautionary actions stimulate consumers to take care while undertaking the hazardous activity. Depending on their willingness to bear risk, some individuals may continue to purchase hazardous products even in the presence of the warning. While consumption often decreases after a hazard warning is published, it is difficult to know whether the warning's influence is too great, too little, or just right. For example, if it were truly desirable to eliminate consumption of the product, then a ban would be preferable to a warning. The role of warnings is to provide risk information when a choice to bear the risk may be rational, but some individuals once apprised of a risk will rationally forgo or take expensive action to ameliorate it.

Similar reasoning underlies many precautionary warnings. For exam-

ple, those who find wearing rubber gloves onerous will not do so when using toilet bowl cleaner, even though the label urges them to do so. Most people do not wear seatbelts when driving cars, even though substantial government efforts have admonished them to do so, going so far as making nonusage subject to fine. Although not wearing seatbelts can be rational, the non-seatbelt-wearers may not accurately perceive the risks they take on, or they may be (rationally) discounting the costs that their accidents impose on society and others in the automobile insurance pool.[15]

Various sources of evidence suggest that hazard warnings do have an influence. Market data best reveal actual risk-taking decisions. For example, in 1963, hazard warnings alerted consumers to the potential tooth-staining risk of tetracycline for children under age eight.[16] Whereas the use of tetracycline by patients aged nine and older continued to increase after 1963, tetracycline use for younger children plummeted from about 400 mentions (new or continuing prescriptions by the doctor surveyed) per 1000 population in 1963 to under 100 mentions by 1974. Similarly, cigarette consumption has been dramatically influenced by the provision of risk information.[17] U.S. per capita cigarette consumption increased steadily throughout this century up to the mid-1960s. In 1965, it became mandatory for cigarette packs to carry warning labels. In the 1970s, cigarette consumption stabilized, and since the 1980s, per capita cigarette consumption has declined. The warning for saccharin has also had an apparent effect on diet soft drink sales. The warning label alerting consumers to the potential cancer hazards for laboratory animals reduced saccharin soft drink sales by 4 percent.[18]

Consumers' responses to surveys about hypothetical products bearing warnings may also be instructive, indicating whether they would purchase the product or take the precautions listed. Evidence on consumers' handling of household chemicals suggests that individuals do take precautions in response to hazard warnings, such as wearing rubber gloves and placing poisons in a childproof location.

The optimal aggregate response to a hazard warning will yield the same response as would be made by hypothetical fully informed people capable of making rational decisions under uncertainty. Do people tend to underreact to the risk or react excessively? One study of hazard warnings in the workplace suggested that at least in some instances, appropriate warnings can lead workers to make roughly the same trade-offs between risk levels and wages for the risks

15. For discussion of the rationality and the potential errors in individual seatbelt use, see Richard Arnould and Henry Grabowski, "Auto Safety Regulation: An Analysis of Market Failure," *Bell Journal of Economics*, 12:27-45 (1981).

16. For discussion of the tetracycline evidence, see W. Kip Viscusi, *Reforming Products Liability* (Cambridge, MA: Harvard University Press, 1991).

17. The cigarette consumption trends are based on data presented in Viscusi, *Smoking*.

18. See Robert G. Orwin, Raymond E. Schucker, and Raymond C. Stokes, "Evaluating the Life Cycle of a Product Warning: Saccharin and Diet Soft Drinks," *Evaluation Review*, 8:801-22 (1984).

communicated in the warnings as for workplace risks that workers had already identified.[19] This result may not generalize to all situations, however.

As a practical matter, evaluating the success of warnings is difficult. We must ask whether consumers receive the message, whether it affects risk perceptions appropriately, and whether consumers' decisions appear to reflect cognizance of the risk levels. Observing that a warning has some effect on behavior is a useful starting point; one knows the warnings were not completely ignored. We need to delve much more deeply, however, before we can judge that an appropriate risk level is being communicated and acted on in an appropriate manner.

CHALLENGES FOR RISK INFORMATION POLICIES

Many of the difficulties associated with hazard communication stem from the difficulties of choice under uncertainty; that is, due to our cognitive shortcomings, people do not always perceive risks accurately and make sound decisions with respect to them.

This suggests four challenges for policymakers. The first is to convey information about very small probabilities without encouraging alarmist responses. By their nature, we tend to have relatively little experience with slight hazards. When it is also unclear what the true risk level is, the relevant information is likely to change over time to reflect new knowledge. The resulting alteration of the risk message may reduce its credibility. So, too, may an indication that there is a range of uncertainty in estimates of the risk's magnitude.

A second challenge is to better utilize the various forms of hazard communication. The almost exclusive emphasis observed at present on on-product warnings, rather than other avenues such as educational programs, has made warning efforts serve as little more than informational sound bites. If we truly wish to educate the public—a task that is particularly important for complex hazards and risks for which there may appropriately be a diversity of individual responses—then greater attention must be paid to other forms of communication.

A third challenge for policy design is to develop and implement criteria for when warnings, rather than other policy options, should be used. Although warnings are well known to be an intermediate policy option between no action and explicit regulatory control, the attention given to the decision to pursue the warning option and to evaluate its success is often inadequate.

The fourth, and perhaps most important, challenge is to develop the appropriate institutional incentives for providing risk information. Excessive information tends to create problems of information overload. As a society, we should alert people to the truly important risks they face so that they understand where care is needed. Many incentives now in place promote overwarning. At

19. See W. Kip Viscusi and Charles O'Connor, "Adaptive Responses to Chemical Labeling: Are Workers Bayesian Decision Makers?" *American Economic Review*, 74(5):942-56 (1984).

present, there is no legal cost for overwarning. Hence companies err on the side of excessive warning to avoid prospective liability costs. Cautious policymakers also are prone to overwarning; for example, pesticide warnings have become increasingly lengthy over time as our knowledge of pesticide risks has improved. These officials do not devote sufficient attention, however, to the impediments that a lengthy warning may pose to people who must utilize the information.

Hazard communication policies can play an important and constructive role within the menu of risk policies. In designing warnings, however, we must recognize that people have cognitive limitations and may make flawed decisions. The challenge to policymakers is to design warning programs to be as helpful as they can be in the presence of such limitations. Hazard warnings are one critical component of the general societal effort to get citizens to confront risks appropriately.