1996

Individual Rationality, Hazard Warnings, and the Foundations of Tort Law

W. Kip Viscusi

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1. *THE ROLE OF HAZARD WARNINGS*

Hazard warnings and other forms of risk information have become increasingly prominent mechanisms for promoting safety. Government-mandated warnings on products continue to proliferate, and private parties have taken advantage of various warning mechanisms as well.

Warnings have a truly substantive economic purpose and are not simply mechanisms for satisfying consumers' "right to know." First, by informing consumers of the risk level associated with a product or an activity, warnings can better enable individuals to make the threshold decision of whether to purchase such a product or to engage in such behavior. A consumer may wonder about the dangers inherent in driving an all-terrain vehicle or using paint stripper. Hazard warnings can assist in providing answers and information regarding the potential adverse consequences of such products and activities, thus better enabling the recipient of the information to make a sound decision. The second function of warnings is to promote accident avoiding behavior within the context of risky activities. Warnings alert consumers to the need to wear rubber gloves while using lye, and they urge workers to avoid the kinds of sharp turns that could lead to tip over a forklift truck. These two functions of warnings overlap in some instances. If warnings lead to a belief that a potentially risky activity is

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safe, then they also may affect the threshold decision of whether to participate in this activity.

Although the discussion of warnings is most concrete for on-product warnings, such as those on cigarette packages, the role of such mechanisms is much more diverse. The overall context of discussion should be sufficiently broad to include not only on-product warnings, but also other mechanisms for hazard communication, such as videos, training manuals, and safety education programs. Because of the perils of scuba diving, participants in that sport are required to become certified for open water diving by one of two major international organizations.[1] This training program includes a detailed discussion of the risks associated with scuba diving and training in how to avoid these risks. Although these hazards cannot be conveyed through a simple on-product warning, such as a label on an air tank, this information transfer is still a warning. However, because the message that must be conveyed is complex, an on-product warning is not sufficient to alert persons to the risks inherent in the activity. Consequently, the overall concern should be whether the entire hazard communication system, including warnings and other mechanisms of information transfer, is sufficient to enable the recipient to make sound risk-averting decisions.

If all people were fully rational and cognizant of all the risks they faced, then they would always select an efficient level of safety in all their activities and other choices. Thus people would trade off the potential benefits of the risky behavior against the costs, including the risks to life and limb, and select the activity and product mix that best promoted their welfare. In such a world, there would not only be no need for hazard warnings, but there also would be no need for liability of any kind. Purchasers of hazardous products, for example, would always value the improved safety associated with safer variants of products and would provide the correct price incentives for product manufacturers to sell safer products through their willingness to pay more for products that provide a greater desired level of safety at an appropriate cost.

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1. The Professional Association of Diving Instructors and the National Association of Underwater Instructors provide certification.

Matters are not always that ideal, however. One potential failing is that consumers may not be fully cognizant of the product risks or with the mechanisms that can be used to reduce these hazards. First time riders on a three-wheeled all-terrain vehicle may not be aware of the need to shift one's body during a turn in order to avoid a tipover and may not even be aware of the vehicle's underlying instability even though these issues are discussed in the owner's manual for the vehicle. Hazard warnings may address these issues, but in some instances the product is so inherently risky that the warnings are insufficient to enable people to use the product safely. The consent decree between the ATV industry and the Consumer Product Safety Commission, prohibiting the sale of new three-wheeled ATVs, can be viewed as an implicit recognition that prohibiting the sale of new three-wheeled ATVs was preferable to simply manipulating the product warning.[2]

The purpose of this paper is to formulate how one should think about such situations. In some instances, it may be desirable to mandate product safety directly, either through government regulation or by imposing tort liability. In other instances, hazard warnings alone may be sufficient. Nevertheless, how are we to judge such warnings and, even if we have an effective warning, how are we to assess whether a warnings policy alone is adequate or whether additional strictures should be placed on the product safety level? This paper will examine the conditions that should be met for effective warnings and whether the utilization of hazard warnings is undertaken efficiently.

The context for defining the role of a warning will be governed by the world in which the warnings policy operates. In particular, similar to technological limitations which affect the feasible safety characteristics of products, cognitive limits of the individual's ability to process warnings determine the role of warnings in influencing behavior. Because people have limited information processing capabilities, it is not feasible to provide them with unlimited warning information. Instead, issues of structure, format, and content become particularly

2. *See* United States v. American Honda Motor Co., Civ. No. 87-3525 (D.D.C. filed Dec. 30, 1987).

salient in one's consideration of warnings. A principal concern is how these cognitive limitations should affect the criteria that should be applied in judging warnings. More generally, to what extent should these limitations influence overall liability doctrines, including the reliance on warnings, as opposed to requirements that influence product safety characteristics directly.

The principal theme of this discussion is that while cognitive limitations may be important and define the context in which warnings are perceived, they do not radically alter how we should think about liability tests or the role of warnings. Individual behavior in averting risks still remains an important component of promoting product safety. To the extent that warnings can effectively provide information that leads to efficient levels of precautions, it would be socially undesirable to foreclose the opportunity to exploit this additional safety-enhancing mechanism. Unfortunately, the tort liability system does not function in a manner that is ideal from the standpoint of the incentives that are created. Tort law currently is asymmetric in terms of its structure. Firms may potentially incur tort liability penalties for underwarning. Yet there are no penalties levied for overwarning. The uncertainty of whether warnings meet the liability test consequently provides incentives for firms to overwarn, thus potentially diluting the efficacy of warning in other contexts as well. This paper will assess the degree to which people can process hazard warning information and how cognitive limits affect the criteria for hazard warnings policy. Government warnings have begun to play an increasing role in society. The government has standardized food nutrition labels,[3] and Congress has mandated the exact wording of warnings for cigarettes[4] and alcoholic beverages.[5]

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3. 21 C.F.R. § 104.5 (1995).

4. The government mandates that cigarette packages must have one of the following labels:

> Surgeon General's Warning: Smoking Causes Lung Cancer, Heart Disease, Emphysema, and May Complicate Pregnancy.
>
> Surgeon General's Warning: Quitting Smoking Now Greatly Reduces Serious Risks to Your Health.
>
> Surgeon General's Warning: Smoking by Pregnant Women May Result in Fetal Injury, Premature Birth, and Low Birth Weight.

Numerous regulatory agencies monitor to varying degrees hazard warnings for jobs, prescription drugs, pesticides, chemicals, and medical devices.[6] The increased prominence of warnings is not an accident. Rather, it reflects a recognition that information can play an important role in promoting safety and, in particular, in taking advantage of the role that potentially injured parties have in limiting the frequency and extent of accidents. Hazard warnings also are attractive because they are an intermediate policy option between no form of regulation and more restrictive measures, such as those that would either ban the product or greatly alter its characteristics.[7] The flexibility of warnings enables those who are unwilling to incur risks to take appropriate precautions or to avoid the risky activity, and also enables individuals who are willing to engage in risky behavior to do so.

A final advantage of warnings is that they promote behavior on a decentralized basis. In many job contexts, the employer can monitor worker actions and the degree to which workers are being careless in carrying out the job operations. But for many consumer products and in some employment contexts as

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Surgeon General's Warning: Cigarette Smoke Contains Carbon Monoxide.

15 U.S.C. § 1333(a)(1) (1994).

5. Any alcoholic beverage must have the following stated on its label: "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." 27 U.S.C. § 215 (1994).

6. The Occupational Safety and Health Administration monitors hazard warnings for employees. 29 C.F.R. § 1910 (1995). The Food and Drug Administration mandates labeling provisions for both prescription drugs, 21 C.F.R. § 201 (1995), and medical devices, 21 C.F.R. § 801 (1995). Warnings on labels of pesticides are prescribed by the Environmental Protection Agency. 40 C.F.R. § 156 (1995).

7. *See generally* W. KIP VISCUSI & WESLEY A. MAGAT, LEARNING ABOUT RISK: CONSUMER AND WORKER RESPONSES TO HAZARD INFORMATION (1987) [hereinafter VISCUSI & MAGAT, LEARNING ABOUT RISK] (analyzing the precautionary behavior of individuals using caustic household cleaners); WESLEY A. MAGAT & W. KIP VISCUSI, INFORMATIONAL APPROACHES TO REGULATION (1992) [hereinafter MAGAT & VISCUSI, INFORMATIONAL APPROACHES] (discussing the intermediate role of warnings).

well, the risky decisions are being made on a decentralized basis where it is impossible to monitor whether precautions are being taken. A drain opener manufacturer does not know whether a consumer will in fact wear rubber gloves while using the drain opener, but the warning message can alert the consumer to the need for taking precautions in hopes that this information will lead people to take the appropriate level of care.

The detailed review of the strengths and limitations of warnings that will follow suggests that there are in fact limitations to effective warnings that courts should take into account. Nevertheless, hazard warnings have played and can continue to play a constructive role in fostering safety-related behavior. These limitations, however, will inevitably affect the criteria courts should apply to hazard warnings and the way in which liability tests should be structured for hazard warnings as well as decisions that directly affect the safety characteristics of products.

2. *THE COGNITIVE CONTEXT*

If individuals had perfect information processing capabilities, then the task of information transfer would be much easier than it is in practice. For example, there would be no need to have patient package inserts for prescription drugs. Pharmaceutical firms could simply refer interested patients to the pertinent scientific literature and let them form their own judgments. Currently, companies do not do this, in part because the cost of providing information is greatly reduced if the information is distilled and provided in conjunction with the product. Moreover, since most people lack a sophisticated scientific background or the time and ability to delve into the nuances of the medical literature, firms summarize the key substantive implications pertaining to the product and how it affects the consumer's decision to buy the product or to decide how it should be used.

In the extreme view, human cognitive limitations might appear to be so significant that it would be irrational to rely on hazard warnings at all. Individuals have limited information processing capabilities and make potentially flawed decisions. To overcome these inherent human weaknesses, we can take

steps to regulate the technological risk characteristics of products, rather than delegate responsibility for safety to individuals who have imperfect decisionmaking abilities.[8]

Professor Howard Latin provides a useful reference point for considering the potential shortcomings of hazard warnings as well as considering the inventory of consumer failings with respect to warnings.[9] Professor Latin argues that the cognitive limitations that impede the effectiveness of warnings provide a rationale for tort liability guidelines with more direct influence over product safety.[10] Although his focus is on hazard warnings, the behavioral phenomena he discusses have wider applications beyond this specific context and are based on findings pertaining to behavior.

Before reviewing the range of possible cognitive failures that can take place, it is important to stress that the existence of shortcomings in cognitive processes does not imply that warnings are completely ineffective. Rather, we must identify which failures are important in a particular warning context and, if the failures are consequential, determine how much they impede the efficacy of the warnings. Specifically, to what extent will decisions diverge from what people would choose to do if they were rational decision makers who possessed sound information processing capabilities?

We should also examine the *prevalence* of the cognitive limitation at issue, that is, look at the limitation's overall effects on groups as well as individuals. How significant is a given shortcoming for the entire class of people making the particu-

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8. The probability that a given situation will deteriorate is aptly summarized by Murphy's Law: "If anything can go wrong, it will." In his commentary on hazard warnings, Howard Latin suggests that individual behavior is so flawed that responsibility should be delegated to firms who would be required to alter the underlying safety characteristics of products. He describes this as "true strict liability." Howard Latin, *'Good' Warnings, Bad Products, and Cognitive Limitations*, 41 UCLA L. REV. 1193, 1292-94 (1994). What I call Howard Latin's Law, which is a variant of Murphy's Law, might aptly be summarized as: "Everything goes wrong." The view that I will adopt here is that matters are not quite so bleak, but that the role of cognitive limitations does require an adaptation on the part of the courts in their liability criteria.

9. *Id.* at 1206-57.

10. *Id.* at 1281-94.

lar warnings decision? In the case of product liability, firms are generally producing products for a mass consumer market. There may, of course, be segments of the market that will not process the information accurately, but if the great preponderance of consumers can effectively comprehend the warning, then the aggregate social welfare loss may not be a vital concern.

In addition, we should also ascertain whether the person experiencing cognitive failure is significant in terms of being the target audience for the warnings. Suppose, for example, that we are dealing with a prescription drug for which the learned intermediary, the physician, is the primary recipient of the warning and will choose the drug that will be prescribed for the patient. It is more important to determine whether the physician will be affected by information processing difficulties than whether the consumer who is not the actual recipient of the information will be able to reliably process the information on the patient package insert.

The first kind of cognitive limitation results from a failure to read warnings at all. Clearly, if warnings are not read, they will not be processed and will have no influence in promoting safety precautions. Due to multiple demands on their time and attention, certain people may simply choose not to read the hazard warnings on a household chemical product or the instruction manual for a lawnmower.

This failure to read warnings is not mere conjecture. Studies of the degree to which consumers read nutrition labeling on food packaging suggest that only one-fourth of all consumers can recall the sodium content listing on food labels and only 40% recall having read the ingredient listing at all.[11] A comparable study of consumer reading of patient package inserts found that only 69-74% of patients who are given prescription drugs with accompanying leaflets claim to have read the leaflets.[12] Another piece of evidence corroborating that some con-

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11. These results are based on a study by JAMES T. HEIMBACH, THE PUBLIC RESPONDS TO LABELING OF THE SODIUM CONTENT OF FOODS (1983).

12. DAVID E. KANOUSE ET AL., INFORMING PATIENTS ABOUT DRUGS: SUMMARY REPORT ON ALTERNATIVE DESIGNS FOR PRESCRIPTION DRUG LEAFLETS 15-16 (RAND Corp. Report R-2800-FDA 1981).

sumers fail to read warnings is that as of July 1970, 73% of Utah residents drank alcohol, but only 35% recall reading the alcoholic beverage warning.[13]

A consumer's functional illiteracy or incompetence may also contribute to his or her failure to effectively process a warning, as would a consumer's loss or destruction of the directions for the product.[14] Information overload may also prove to be an impediment to effective processing of warnings because consumers may be inundated with so many pieces of information that they cannot process all the warning messages they receive. Finally, consumers may neglect to process the warnings because they are relying on other factors, such as learned intermediaries or their own general knowledge.[15]

A useful appropriate reference point for thinking about warnings is whether the information contained in the warning ultimately will have any economic impact. As a general rule, information provided in a warning that does not achieve the effect of altering an individual's behavior has no value to the individual targeted by the warning.[16] This rule excludes consideration of factors such as anxiety or fear which may, of course, be alleviated by the information provided. For the most part, the purpose of warnings is to foster sound consumer decisions about choosing potentially risky activity or taking precautions when pursuing that activity. If the warning information would not alter these decisions, then there will be no effect on the risk or benefits of these choices or on consumer welfare more generally.

A second class of cognitive failures results when the warnings are read but not understood. The warning may include excessive detail that is difficult for consumers to process or to

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13. *See* Debra L. Scammon et al., *Alcohol Warnings: How Do You Know When You've Had Too Many*, 10 J. PUB. POL'Y MKTG. 214 (1990).

14. See Professor Latin's discussion for documentation of these and other related phenomena. Latin, *supra* note 8, at 1207-20.

15. This reliance may not necessarily be misplaced if, for example, the learned intermediary will process the information more effectively and transmit it in a manner that will better enable the consumer to make a sound decision.

16. *See* HOWARD RAIFFA, DECISION ANALYSIS: INTRODUCTORY LECTURES ON CHOICE UNDER UNCERTAINTY (1968).

assess precisely the probabilities associated with the potential consequences of a product's use. Thus the implications of a consumer's intended actions may be uncertain (for example, a consumer may not be able to determine accurately what the risk is that a severe skin burn will result from failure to wear rubber gloves while using lye). This cognitive limitation may be due in part to the fact that consumers have inadequate expertise regarding this particular class of risks. Another difficulty may result when the level of risk varies due to a heterogeneous population of consumers. Diabetics, for example, may face greater risks from consuming alcoholic beverages and smoking than non-diabetics. Also, the way in which the risk issue is framed by the warning may have important implications for how that information is processed. For instance, if I were to inform you of the risk of driving without a seat belt in terms of the risk per car trip, the risk per mile, or the annual risk of such behavior, you might reach very different conclusions about the magnitude of the risk depending on which particular frame of reference I utilized in my warning.[17]

Even if individuals receive and understand warnings, they may nevertheless fail to follow them for a variety of reasons. Consumers may forget the warnings, they may have excessive confidence in their own ability to avoid the risk, or they simply may not believe the warnings. A consumer's failure to heed a warning, even when read and understood, highlights the difficulty of determining what is in fact a "good" warning. A good warning is one that enables consumers to form accurate risk judgments and provides information that is sufficiently salient so that consumers will undertake the desired behavior. If a warning fails to convey information in a credible manner, the resulting shortcoming should be judged a failure of the warning itself rather than of warnings policies more generally.

Note that it may also be the case that a consumer fails to follow a warning and nevertheless makes a sound decision.

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17. Professor Latin also alludes to other forms of failures in decision making, such as the representativeness heuristic, the availability heuristic, and cognitive dissonance. Latin, *supra* note 8, at 1229-35. Nevertheless, these are shortcomings of decisions more generally and are not problems that have been specifically documented with respect to the role of hazard warnings.

Warnings are advisory in nature, not mandatory. Consider the case of wearing rubber gloves while using household chemical products. Wearing gloves surely is desirable from the standpoint of promoting safety. On the other hand, wearing gloves may seem bothersome and unappealing to people who do not generally wear gloves while performing household chores. Depending on the extent of the risk and the degree of discomfort associated with wearing gloves, people could rationally decide not to wear gloves while undertaking such activities.

Indeed, this example has been documented explicitly through empirical evidence demonstrating the degree of disutility that the typical consumer experiences with respect to wearing rubber gloves.[18] If low severity and frequency of injury is associated with not wearing rubber gloves, it would be quite reasonable for people to choose not to wear rubber gloves in such contexts. A premise underlying many warnings policies is that an element of individual discretion should be present in decisions about whether to follow warnings because of the heterogeneity of risks and the heterogeneity of costs associated with precaution taking. Thus the failure of certain consumers to obey a warning should not necessarily be viewed as a failure of the warnings policy but may instead be a result of the open-ended nature of decision making that is possible even in a world with fully effective warnings.

The presence of individual discretion over decision making is not only a complicating factor in warnings contexts, but also is encountered when the issue of choice is considered more generally. Most of the evidence specifically documenting these various cognitive failures tends to involve choices made under risk and uncertainty and not choices made in warnings contexts *per se*. These studies often do not document the extent to which individuals' decisions diverge from optimal behavior. What remains to be assessed is how significant various cognitive limitations are in any particular warnings context, and the extent to which the limitations impede sound decision making.

Finally, it is vital to keep in perspective that warnings decisions is just one category in the vast realm of decisions made

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18. *See* VISCUSI & MAGAT, LEARNING ABOUT RISK, *supra* note 7, at 68-70.

in life. How do the potential problems arising from cognitive limitations in warnings situations compare with the problems that result from any other decision that may be affected by similar deficiencies in choice? Are warnings decisions really so momentous when viewed in a broader context? Literature regarding the effectiveness of warnings often refers to situations involving products such as BB guns and lawnmowers.[19] The courts may be properly concerned with our ability to process information with respect to these areas of choice. Realistically, though, how do the consequences of mistaken decisions about such products compare with the potential losses that may result when we make truly fundamental choices throughout the course of our lives, such as the choice of our career, school, religion, or spouse? Almost invariably, these other nonproduct risk decisions may lead to much greater social losses than those associated with erroneous choice in a hazard warnings context. These are also decisions made under uncertainty. Yet there is little activity on the part of the courts to impose sanctions that would reduce these failures. Nor has there been any government regulation to try to control these choices in the absence of tort liability.

3. *THE POTENTIAL RATIONALITY OF INDIVIDUAL DECISIONS*

The foundation of economic analysis of choice is based on the rationality of individual decision making. As a consequence of consistent and rational choices, economists have established a number of relationships. For example, consumers generally buy less of the product as the price goes up. Workers are more willing to supply their labor at higher wage rates.[20] For any given level of riskiness, stockholders prefer higher profit enterprises.

Nevertheless, even in the context of risks, people make rational decisions based on a variety of components. Individual

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19. These examples are used in the discussion by Professor Latin, *supra* note 8, at 1260-61, 1265-68, 1271-73 and are not uncommon in other assessments as well.

20. There are, of course, problems of backward bending labor supply curves whereby paying workers too much money makes leisure relatively more attractive.

tradeoffs between risk and other attributes are, for example, reflected in risk-money tradeoff valuations. Workers require additional pay to accept jobs that pose greater risk. On average, for each additional occupational fatality, workers are compensated on the order of $3-7 million.[21] Thus, at the midpoint estimate of the value of life of around $5 million, the average worker receives an additional wage premium of $500 per year to face an additional annual death risk of 1/10,000. For a group of 10,000 similarly situated workers who receive $500 per year more in compensation, the total additional annual compensation will be $5 million for each one statistical death. Hence, economists generally refer to the implicit value of life in this instance as being $5 million. What should be emphasized, however, is that the issue of concern is not the value of a certain death but rather the value of a low probability of death.

The premiums that workers receive for nonfatal risks also follow an expected pattern that bolsters the character of this evidence.[22] Consider, for example, the differences in the risk premium commanded by different segments of the population who differ in their attitudes toward a given risk. One would expect individuals who are more willing to bear risk to incur job hazards for a low value per unit risk, and those who are less willing to bear risk to require a higher amount of wage compensation per unit risk. This pattern is in fact borne out in terms of the preferences of different groups that take various safety precautions. For example, nonsmoking seat belt users have the highest value of injuries; their implicit value of an on the job injury is $83,200. Next in terms of unwillingness to incur job injuries and demands for additional compensation are people who take only one of the two precautions relating to seat belt use and cigarette smoking. Smoking non-seat belt users receive the lowest wage premiums for job risks, receiving an average of $26,100 for each statistical job injury. Thus the way in which workers sort themselves among jobs and the compensation they require to bear risks is very much in line

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21. *See* W. KIP VISCUSI, FATAL TRADEOFFS: PUBLIC AND PRIVATE RESPONSIBILITIES FOR RISK (1992) [hereinafter VISCUSI, FATAL TRADEOFFS].

22. *See* Joni Hersch & W. Kip Viscusi, *Cigarette Smoking, Seatbelt Use, and Differences in Wage-Risk Trade-Offs*, 25 J. OF HUM. RESOURCES 202 (1990).

with what one would expect based on a rational economic choice.

The nature of the life at risk is also not homogeneous. Older workers have less to lose in terms of the quantity of life than do younger workers. The evidence also suggests that this quantity of life is reflected in the wage premiums workers receive.[23]

This kind of evidence is not restricted to the labor market. Product markets respond in a similar fashion to individual attitudes toward risk. Economists have documented a variety of money-risk tradeoffs reflected in individual choices of smoke detectors, seat belt use, and property value responses to air pollution risks.[24]

Similarly, the evidence for used cars and consumer purchases of these cars bolsters the implications of the labor market evidence. Whereas workers on jobs encounter these risks on a continuing basis and would be expected to acquire information over time about these risks through their job experience, car purchasers would tend to have less refined knowledge of the risk across different automobile makes, at least to the extent that this information is gained through direct experience. Nevertheless, there is strong statistical evidence indicating that safer used cars do in fact command a higher price.[25] Indeed, these consumer decisions, as reflected in the choice of the car, indicate that car purchasers have about a $3 million value of life.[26] Thus a car that posed an additional fatality risk of 1/100,000 would command a premium of $30 in the used car market.

An interesting aspect of the car purchase decision is that consumers are buying a durable product. Safer cars will provide for greater safety throughout the life of the product, not

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23. *See* W. Kip Viscusi & Michael J. Moore, *Rates of Time Preference and Valuations of Duration of Life*, 38 J. PUB. ECON. 297 (1989).

24. For a review of these studies, see VISCUSI, FATAL TRADEOFFS, *supra* note 21, at 223-45.

25. Such evidence is controlled for a variety of other car attributes, such as size and fuel efficiency.

26. *See* Mark Dreyfus & W. Kip Viscusi, *Rates of Time Preference and Consumer Valuations of Automobile Safety and Fuel Efficiency*, 38 J.L. & ECON. 297 (1995).

simply in the initial year. Are consumers myopic in thinking about these safety properties? Estimates of consumer interest reflected in car buyers' valuation of the long-term safety aspects of cars suggests that these rates are in fact in a reasonable range. One can certainly reject on a statistical basis the possibility that consumer decisions completely ignore the future consequences of their automobile purchases.[27]

4. *PATTERNS OF RISK PERCEPTION ERRORS*

The usual assumption underlying much of tort liability is that consumers of risky products systematically underassess the risks. As a result, additional tort liability or strict liability for the product injury is required to provide manufacturers with the appropriate incentive to produce safe products.

There are, of course, situations in which consumers do in fact underestimate the risk. Some hazards may be hidden, and they may involve risk consequences that are not well publicized. It is doubtful, for example, whether asbestos workers in the shipyards during World War II understood the full extent of the risks posed by their asbestos exposures.

This situation of risk underestimation is not necessarily the norm. Indeed, there are many important classes of risks for which there is a tendency to overestimate the risk rather than to underestimate it. Figure 1[28] presents the pattern of risk perception for a wide class of risks of mortality. The horizontal axis presents the actual number of deaths per year from these various causes, and the vertical axis is the perceived number of deaths. If risk perceptions equal the actual risk level, all observations would fall on the 45 degree line. It is noteworthy, however, that there is a systematic bias in the nature of risk perceptions. Low probability risks, such as those from botulism and tornadoes, tend to be overestimated. In contrast, very large risks, such as our lifetime risk of being killed from heart disease or cancer, tend to be underestimated. This pattern is quite systematic in that it relates to the magnitude of the risk. To the extent that people overestimate low probability events,

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27. *See id.*

28. *See* W. KIP VISCUSI ET AL., ECONOMICS OF REGULATION AND ANTITRUST 662 (1992).

it is likely that product risks that also tend to be low probabilities may also be overestimated because of the bias associated with misperceptions based on risk magnitude.[29] Of course, this result assumes that individuals are cognizant of the class of risks associated with the product and that this risk is not a hidden hazard that they do not even know exists.

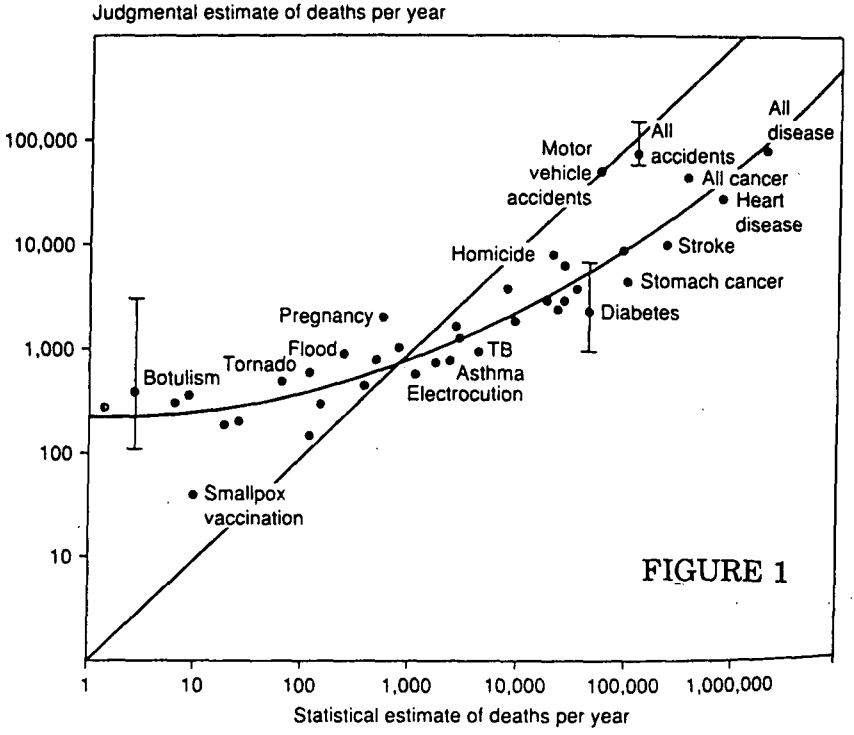

FIGURE 1

The second attribute of a risk that strongly affects how individuals react to it concerns the degree of ambiguity. One of the more famous biases in economics is associated with the Ellsberg Paradox.[30] The Paradox hypothesizes that individuals have a chance of winning a prize by drawing a ball from

29. For a formal rationale for this systematic bias with respect to the magnitude of the risk, see VISCUSI, FATAL TRADEOFFS, *supra* note 21, at 102-10.

30. D. Ellsberg, *Risk, Ambiguity, and the Savage Axioms*, 75 Q.J. ECON. 643 (1961).

one of two urns. Suppose that urn one has a fifty-fifty mix of red and white balls and you win a prize by drawing a red ball. In contrast, urn two has 100 balls that are red and white, but you are uncertain of the exact mixture. Prior to drawing a ball, you can choose which color ball would result in the awarding of a prize from urn two. If you had a choice between the two urns, which urn would you select to give you a chance of winning a prize? The great preponderance of subjects prefer urn one which offers the precise probability of success even though urn two is probabilistically equivalent in terms of the mean probability of success. For example, you can guarantee yourself a "hard" 0.5 probability of success with urn two by selecting a color based on the flip of a coin.

In addition to being averse to ambiguous chances of success, there is also evidence that people are averse to ambiguous chances of incurring a loss. Table 1[31] summarizes an experiment in which individuals confronted differing risks per million residents of nerve disease from air pollution exposures.[32] In the first panel, individuals received risk information from two experts, one of whom believed the risk was 150 per million and the other who believed the risk was 200 per million. The mean risk that respondents viewed as equivalent to this risk range was 178 per million, which is just above the midpoint of the risk range of 175 per million. If the extent of ambiguity is increased, as in panel 2, there is much greater aversion to the uncertainty involved. When one expert believes the risk is 110 and the other assesses it at 240, the average of the risk assessments remains at 175. Respondents view the mean risk that is equivalent to this risk range as being equivalent to 191, however. In the case of losses, consequently, we have the counterpart of the Ellsberg Paradox: people will be unwilling to incur ambiguous risks of suffering losses. Put somewhat differently, the worst case scenario will tend to loom disproportionately large in their judgments about the magnitude of the risk.

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31. *See* VISCUSI, FATAL TRADEOFFS, *supra* note 21, at 144.

32. *See* W. Kip Viscusi et al., *Communication of Ambiguous Risk Information*, 31 THEORY & DECISION 159 (1991).

TABLE ONE: RISK AMBIGUITY AVERSION AND THE SIZE OF THE NERVE DISEASE RISK SPREAD

RISK LEVELS IN AREA A	*SAMPLE SIZE*	*MEDIAN*	*MEAN*	*STANDARD ERROR OF MEAN*	*MINIMUM (#)*	*MAXIMUM (#)*
Panel 1: Risk Ambiguity 150,200	65	175.00	178.35	1.24	150.50 (1)	200.00 (1)
Panel 2: Size of Spread Effect 110,240	58	180.00	191.08	3.95	115.00 (1)	240.00 (13)

This result suggests that for product risk choices, individuals may not always feel confident in their knowledge of the level of the risk. This, however, does not necessarily imply that the risk will be ignored. Indeed, to the extent that their knowledge is imprecise as a result of conflicting risk information, the overall tendency documented in the literature is that they will tend to be excessively averse to the risk. People will display ambiguity aversion, thus avoiding situations in which they cannot precisely quantify a hazard. Perhaps for that reason, consumers often react with alarm to publicized risks such as newly discovered carcinogens, or to other threats, such as breast implants, for which there is substantial scientific debate but no firm resolution of the extent of the risks that may in fact be present.

Another facet of the risks that is consequential in influencing individual behavior is whether information regarding the risk has indicated a change in the risk level. In particular, consumers tend to overreact to increases in risk as opposed to risk decreases. The existence of this phenomenon as well as the role of potential overestimation of risk is reflected in the following example of consumer valuations of improved safety of household chemicals.[33] Table 2[34] summarizes consumers' responses to differing changes in the risk for two products.

33. MAGAT & VISCUSI, INFORMATIONAL APPROACHES, *supra* note 7, at 60.

34. *See id.*

TABLE TWO: MARGINAL VALUATIONS OF REDUCING BOTH RISKS BY 5/10,000

INCREMENTAL WILLINGNESS TO PAY (DOLLARS/BOTTLE)

STARTING RISK (INJURIES/ 10,000 BOTTLES)	*INHALATION— SKIN POISONING*	*INHALATION— CHILD POISONING*	*GASSING— EYEBURN*	*GASSING— CHILD POISONING*
15	1.04	1.84	.65	.99
10	.34	.54	.19	.24
5	2.41	5.71	.83	.99

The first column indicates the starting risk of injury per 10,000 bottles of a product, which begins at 15/10,000. Each of the columns indicates consumers willingness to pay in terms of additional price per bottle for reducing the risk by 5/10,000 for the amount shown in the first column. Thus the first entry in the second column of the table indicates the valuation consumers place on reducing the risks of inhalation and skin poisoning from insecticide by 5/10,000, which they believe is worth $1.04 per bottle. Parents with children were asked how valuable it would be to reduce the risk of inhalation and child poisoning by 5/10,000. These parents believed reducing the risk would be worth $1.84. The final two columns of Table 2 pertain to risks associated with toilet bowl cleaner, which have an initial value of $0.65 for reducing the risks of gassing and eye burn by 5/10,000 and a value of $0.99 for reducing the risks of gassing and child poisoning by this amount. The next row in the table gives the incremental value for the next successive reduction of the risk. Once the risk level has been reduced to 10/10,000, the issue becomes how much would consumers be willing to pay for an additional risk reduction. This amount is less than one would expect since people should have a diminishing willingness to pay for improvements in product safety. The final row of the table is quite striking in that it indicates the amount that people would pay to completely eliminate the risk once it has reached a level of 5/10,000. That risk decrement has a value that jumps to the highest value observed in each of the columns. Consumers are much more willing to pay for a risk decrease that completely eliminates the risk even though the magnitude of the risk reduction is no greater than

is achieved in the previous rows of the table.

This anomaly affects two underlying phenomena. First, to the extent that low probability risks are overestimated, individuals may in fact perceive the risk reduction of 5/10,000 to zero as being greater in magnitude than a risk reduction from 10/10,000 to 5/10,000 even though statistically they are the same. Second, a risk reduction to zero eliminates the need to worry about the risk at all, thus alleviating risk concerns by more than might be simply captured with a reference to the shift in probability involved.

The results in Table 2 indicate how consumers would respond to successive reductions in the risk of injury from these household chemical products by 5/10,000. What if this question were turned around so that instead of purchasing decreases in risk, consumers were faced with a prospect of a risk increase for which they were offered a price discount? How would the discounts required compare with the amounts that consumers were willing to pay for a risk decrease? For infinitesimally small changes in risk, the amounts per unit of risk reduction should be identical.

The results in Table 1 indicate how the same sample of consumers responded to a risk increase of 1/10,000, which was one-fifth of the size of the risk decrease that was the subject of their responses in Table 2. In pretesting of the survey, consumers were given the option of responding to a risk increase of 5/10,000, which is the same amount used for the risk decrease questions. Yet the consumer response was so negative that it threatened the viability of the survey. The results in Table 3[35] indicate that even with a fairly modest increase in risk, consumers were highly reluctant to purchase products that had increased in risk at any price. Depending on the injury pair involved, from 62% to 77% of respondents believed that the product was too risky to purchase even if a price discount were offered, and, if that was not sufficient, they would be paid to use the product. Moreover, for the very small segment of consumers who were willing to name a finite price cut that they found acceptable, the magnitude of this price reduction was

35. *See* MAGAT & VISCUSI, INFORMATIONAL APPROACHES, *supra* note 7, at 63.

considerable. In the case of inhalation-skin poisoning, the mean price reduction per bottle required for consumers to be indifferent to a risk increase of 1/10,000 was $2.86, where their starting risk value was 15/10,000. In contrast, this consumer group was only willing to pay $1.04 for a risk decrease of 5/10,000 from the same starting value. The risk reduction per unit risk that was required was more than an order of magnitude greater than the willingness to pay per unit risk for a risk decrease.

TABLE THREE: RESPONSES TO RISK INCREASE (+1,+1) VALUATION QUESTIONS[36]

INJURY PAIR	*PERCENTAGE FOR WHOM PRODUCT IS TOO RISKY TO PURCHASE*	*MEAN VALUE ($/BOTTLE) OF POSITIVE RESPONSES*
Inhalation—Skin Poisoning	77.2	2.86
Inhalation—Child Poisoning	68.1	3.19
Eyeburns—Gassing	61.5	5.52
Gassing—Child Poisoning	74.3	1.28

This asymmetry suggests that consumers are quite reluctant to depart from their current risk reference point. Other researchers have subsequently designated this phenomenon a status quo bias in which people are quite reluctant to depart from their accustomed risk level.[37]

This phenomenon has particularly important implications for how consumers view product risks and, in particular, how they view new risks that are called to their attention either through hazard warnings, public information dissemination, or some other means. Perceived risk increases are likely to be

36. This question asked subjects what price discount they would require on the new product to accept an additional risk of 1/10,000 for both injuries, starting with risks of 15 injuries per 10,000 bottles sold for both injuries.

37. William Samuelson & Richard Zeckhauser, *Status Quo Bias in Decision Making*, 1 J. RISK & UNCERTAINTY 7 (1988).

viewed with alarm, resulting in a significant danger of overreaction to warnings with respect to new risks that consumers did not view as an accustomed characteristic of the product.

Another systematic characteristic of risk perceptions is that highly publicized risks tend to be overestimated.[38] Natural disasters such as tornadoes and floods tend to receive substantial publicity, which accounts in part for their high risk perception that was shown in Figure 1. Similarly, there has been substantial risk information disseminated with respect to cigarettes both in the media and through hazard warnings, the net effect of which is that consumers may overestimate the risk.

TABLE FOUR: SMOKING FATALITY RISK PERCEPTIONS[39]

SAMPLE	*MEAN (STANDARD ERROR OF THE MEAN)*	
	LUNG CANCER FATALITY RISK	*TOTAL SMOKING MORTALITY RISK*
Full Sample	.38 (.02)	.54 (.07)
Current Smokers	.31 (.04)	.47 (.05)
Current Nonsmokers	.40 (.02)	.56 (.03)
Former	.36 (.03)	.50 (.04)
Never	.42 (.03)	.59 (.03)

Consider the data that are summarized in Table 4.[40] This information pertains to the smoking fatality risk perceptions of smokers based on a regional sample. Results for a national sample pertaining to lung cancer risk perceptions yield even

38. *See* BARUCH FISCHHOFF ET AL., ACCEPTABLE RISK (1981) (offering a critical analysis of risk determination).

39. Sample size = 206.

40. *See* W. KIP VISCUSI, SMOKING: MAKING THE RISKY DECISION 77 (1992) [hereinafter VISCUSI, SMOKING].

starker results as the population perceives the lung cancer incidence rate among smokers to be 0.42, whereas estimates based on the scientific literature would put that risk from three to seven times smaller.[41] As the data in Table 4 indicate, the majority of people view the lung cancer fatality risk of smoking to be 0.38 and the total smoking mortality risk to be 0.54. As one would expect, smokers view their prospects more favorably; they consider their lung cancer fatality risk to be 0.34 and the total smoking mortality risk to be 0.47.

TABLE FIVE: ACTUAL SMOKING RISK RANGES IN 1985 AND 1991

SURVEY YEAR	*LUNG CANCER MORTALITY RISK TO SMOKER*	*TOTAL MORTALITY RISK TO SMOKER*	*TOTAL MORTALITY RISK TO SOCIETY*
1985	.05 - .10	.16 - .32	.21 - .42
1991	.06 - .13	.18 - .36	.23 - .46

If we compare these risk perception amounts to scientific evidence pertaining to the true estimated risk level shown in Table 5,[42] then the pattern of overperception of the risks is clearcut. As of 1991, the survey year that gave rise to the data in Table 4, the estimated lung cancer mortality risk to smokers was 0.06-0.13. Therefore, even the upper bound of this possible risk range lies considerably below risk estimates. Similarly, the total mortality risk to smokers is also overestimated, though to a lesser extent than is the lung cancer mortality risk, which is the risk component that has received the greater publicity.[43] The final column in Table 5 indicates the total mortality risks to society, including the risks of environmental tobacco smoke, genetic damage, and fires. Even the upper

41. For a report of these results, see *id.* at 70.

42. *See id.*

43. For example, the risks of lung cancer were featured in the inaugural governmental information effort against smoking. U.S. DEP'T OF HEALTH, EDUC. & WELFARE, SMOKING & HEALTH: REPORT OF THE ADVISORY COMM. TO THE SURGEON GEN. OF THE PUB. HEALTH SERV. (1964).

bound of this risk range, which includes risks beyond those to smokers themselves, is a bit below the total smoking mortality risk perception of both the entire population as well as current smokers.

Hazard warnings also may create excessive perception of small risks. This danger is particularly great in situations in which the warning language utilized is adapted from an existing warning for risk that is relatively great. A notable example of this was California's Proposition 65, which imposed hazard warning labels on food products that contained potential carcinogens or reproductive toxicants. The proposed wording of the warning under California Proposition 65 was as follows: "WARNING: The state of California has determined that this product is dangerous to your health."[44] Thus, this warning is a variant of the 1969 cigarette warning that was in place through the early 1980s.

TABLE SIX: COMPARISON OF CALIFORNIA WARNING WITH OTHER WORDINGS

HAZARD WARNING	*FRACTION WHO REGARD OTHER AS LESS RISKY*	*FRACTION WHO REGARD OTHER AS MORE RISKY*	*FRACTION WHO REGARD OTHER AS EQUALLY RISKY*
Use of this product may be hazardous to your health. This product contains a chemical that has been determined to cause cancer in laboratory animals.	.56	.26	.18
Warning: The state of Illinois has determined that this product is dangerous to your health.	.36	.16	.48
Caution: Use of this product may be hazardous to your health.	.14	.17	.69

44. For further discussion, see W. Kip Viscusi, *Predicting the Effect of Food Cancer Risk Warnings on Consumers*, 43 FOOD DRUG COSM. L.J. 283 (1988).

Table 6[45] summarizes the responses of the group of 99 adult consumers to various risk comparisons. The reference point was the suggested wording under California Proposition 65, with the only change being that the "state of California" was replaced by the "state of Illinois" to better match the subjects' resident state. As a result, the reference point warning was the following: "WARNING: This product contains a chemical known to the state of Illinois to cause cancer." Respondents were then asked to compare this warning with three other warnings to assess which warning implied a greater risk. The first warning listed in Table 6 is the wording used for the saccharin warning for consumer products containing saccharin. The 1 in 100,000 lifetime fatality risk threshold for Proposition 65 warnings is approximately 40 times as small as the estimated lifetime risk posed by saccharin.[46] Even though the saccharin risk is in fact greater than the risk threshold for Proposition 65, 56% of the respondents regarded the saccharin warning as indicating a lower risk, and 18% viewed it as posing an equal risk. Only 26% of the respondents regarded the saccharin risk warning as conveying a greater risk level.

The second comparison warning in Table 6 is a variant of the 1969 cigarette warning, with the main difference being that the state of Illinois is the source of the warning rather than the Surgeon General. Approximately half of the respondents viewed this cigarette warning as indicating an equivalent risk to the Proposition 65 warning, and just over one-third of the respondents viewed the cigarette-based warning as posing a greater risk.

The final comparison warning in Table 6 is identical to the 1965 cigarette warning. Overall, 69% of the sample viewed this cigarette warning as indicating an equal risk to the Proposition 65 warning, with the remainder being roughly divided between the other two categories of riskiness.

These results suggest that by mimicking much of the wording of the cigarette warning, the proposed warning under California Proposition 65 also indicates a risk that is equivalent in

45. *See id.* at 307.

46. *See* Curtis C. Travis et al., *Cancer Risk Management: A Review of 132 Federal Regulatory Decisions*, 21 ENVTL. SCI. TECH. 415, 417 (1987).

magnitude. Since the assessed risk of smoking to smokers themselves is many orders of magnitude larger than the risk threshold for California Proposition 65, we run the danger of creating a situation of excessive alarm. One product that violated the risk guidelines and was subject to the warning requirements was Liquid Paper. This product was able to avoid warning because of manufacturer reformulation. If the manufacturer had not done so, consumers would have in effect received a warning for Liquid Paper that indicated a risk comparable to that of cigarettes. Such warnings create a danger that may induce undue complacency with respect to the risk of smoking if consumers rightfully believe that Liquid Paper did not in fact pose a major risk to their lives.

5. *THE POTENTIAL EFFICACY OF HAZARD WARNINGS*

Notwithstanding the difficulties individuals often have in processing risk information, hazard warnings can be a potentially effective tool in altering individual perceptions and influencing risk-taking decisions. This section will assess hazard warnings from the perspective of a hazard communication system. Rather than examining whether warnings per se are adequate, this section will focus on whether all information that the representative consumer receives is sufficient to enable the consumer to make reliable risk judgements.[47]

A substantial amount of literature has documented that warnings are not particularly effective when their approach is simply to browbeat consumers into changing their ways.[48] Warnings that serve as reminders to consumers, such as the urging to buckle seat belts, generally were not effective in influencing behavior.[49] Indeed, this lack of efficacy of warn-

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47. This information will include prior knowledge about the product, past experience in using the product, and information from a variety of sources, possibly including warnings but also other sources of information, such as the instructions provided with the product or special training programs.

48. *See* Robert S. Adler & R. David Pittle, *Cajolery or Command: Are Education Campaigns an Adequate Substitute for Regulation?* 2 YALE J. ON REG. 159 (1984) (discussing the limitations of information and education campaigns to change consumer behavior).

49. The ineffectiveness of warnings is demonstrated in the National

ings has been so great that many observers have concluded that warnings are simply not an effective means for influencing consumer behavior.[50] This conclusion has proven to be shortsighted, as it has been based on inferences derived from situations in which warnings were not designed in a manner that would enable them to have a constructive role. The key criterion for judging the efficacy of a warning is the extent to which it provides new information in a convincing manner.[51] This hypothesis with respect to warnings was explicitly tested using data for four different workplace chemicals. Table 7[52] provides information regarding worker responses to four different chemical labels. The impact of warnings in influencing behavior can be assessed by comparing the differing worker responses to the information presented.

Table 7 consists of four columns of data regarding the four different labeling groups. Workers received different hazard warnings for each of the four different chemicals: sodium bicarbonate, chloroacetophenone (an industrial chemical that causes tearing), asbestos, and TNT.[53] Participants in the survey were

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Highway Traffic Safety Administration's ("NHTSA") comprehensive three-year education campaign to increase safety belt use. *Id.* at 171. NHTSA's warning campaign encompassed mass media, education incentive, and private mandatory use programs. *Id.* Yet, at the two-year evaluation of NHTSA's campaign, the agency found that the national seat belt usage increased from 11.3 to 13.9%. *Id.* at 176. The result fell short of NHTSA's goal of 25% safety belt use. *Id.* at 177.

50. *Id.*

51. *See* W. Kip Viscusi & Charles J. O'Connor, *Adaptive Responses to Chemical Labeling: Are Workers Bayesian Decision Makers?*, 75 AM. ECON. REV. 942, 948-56 (1984).

52. *See* VISCUSI & MAGAT, LEARNING ABOUT RISK, *supra* note 7, at 113.

53. The following represents excerpts of each hazard label:

SODIUM BICARBONATE SPILL: Sweep-up, place in an appropriate chemical waste container.

CHLOROACETOPHENONE. WARNING! LACHRYMATOR—VAPOR AND DUST EXTREMELY IRRITATING. Don't breathe dust or vapor. Wear a self-contained breathing apparatus.

ASBESTOS. DANGER! CANCER HAZARD. Use with a NIOSH-Mesa approved respirator. Use with approved goggles.

TNT—(blend of dry Trinitrotoluene). DANGER! HIGH EXPLOSIVES. MUST BE STORED IN ACCORDANCE WITH FEDERAL

told that the chemical indicated in the warning would replace the chemicals with which they now worked as part of their job.

TABLE SEVEN: MEANS OF VARIABLES FOR EACH LABELING GROUP

RISK VARIABLE	*SODIUM BICARBONATE (n=31)*	*CHLORACETO—PHENOME (n=106)*	*ASBESTOS (n=102)*	*TNT (n=96)*
Risk before the warning	.12	.10	.09	.10
Risk after the warning	.06	.18	.26	.31
Risk premium ($1982)	0	1,919.01	2,995.59	5,158.31

The first two rows in Table 7 indicate the shift in risk preferences after receiving the new chemical. Row one indicates the risk beliefs before seeing the chemical label, and row two indicates the risk assessment after seeing the hazard warning label. The metric used for these assessments is the equivalent annual probability of injury that the worker views as being tantamount to the risk posed by the job. In the case of sodium bicarbonate, workers initially assessed the risk as being an average annual frequency of 0.12, which they then lowered to 0.06 after learning that their current workplace chemicals would be replaced by baking soda.[54] The subsequent three columns of chemical labels all begin with workers whose risk perceptions are in the vicinity of 0.10. After being shown the warning for the hazardous chemical, workers raised these risk beliefs considerably. The greatest reactions to the information

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REGULATIONS. KEEP IN COOL, DRY, WELL VENTILATED, LOCK-UP AREA.

Viscusi & O'Connor, *supra* note 51, at 948. The sodium bicarbonate sample can be viewed as a control group because household baking soda is essentially risk-free.

54. It is noteworthy that 0.06 is the accident frequency rate for the chemical industry in the survey year.

were for asbestos and TNT, for which the risk beliefs were roughly tripled by the provision of the risk information.

The third row in Table 7 provides information regarding the risk premium that workers would require to work with the new chemical that was shown in the warning label.[55] Although workers did not require additional compensation to work with the safe chemical, sodium bicarbonate, their annual risk premium in 1982 dollars for the other three chemicals ranged from almost $2,000 to over $5,000 in the case of TNT. Moreover, these risk premiums per unit risk are comparable to what is observed for workers currently in the U.S. workforce who face actual risks of job injury.[56] This job risk study involving a sample of over 300 workers in the chemical industry leads to the conclusion that hazard warnings can influence risk beliefs and in turn attitudes toward accepting a job. Indeed, many workers in the sample indicated that they would quit their job if they were not compensated to face the added risk (73% for TNT) and that they would be unwilling to take the job again under these conditions. This survey focused on the risk perception aspect, and it also revealed whether workers would make the discrete choice of engaging in the risky activity as opposed to taking specific precautions.

Similarly, hazard warnings can affect the consumption of a risky product so that the discrete risky activity participation choice in product contexts is also amenable to the influence of warnings. Figure 2[57] indicates the U.S. total per capita cigarette consumption over the 1900-1990 period. The three different eras of hazard warnings appear in the graph. As is evident from this trend, per capita cigarette consumption was on the rise through the mid-1950s. At that point, substantial public

55. A large body of economic theory suggests that workers will require a compensating wage differential to work on a job that poses added risk. This doctrine, which has been in place since the time of Adam Smith, is borne out quite strongly in these results. Viscusi & O'Connor, *supra* note 51, at 945.

56. In particular, the implicit value of injuries as estimated using an earnings equation is shown to be comparable for the hazard warning group to the estimates obtained before the warnings were in place. *Id.* at 942-56.

57. *See* VISCUSI, SMOKING, *supra* note 40, at 54.

dissemination of adverse information with respect to smoking increased, which culminated in the 1964 release of the U.S. Department of Health, Education, and Welfare report on the lung cancer risks of smoking.[58] In part because of this information as well as subsequent warnings, there has been a dramatic shift in the public's perception of smoking risks and a subsequent decline in smoking rates.[59]

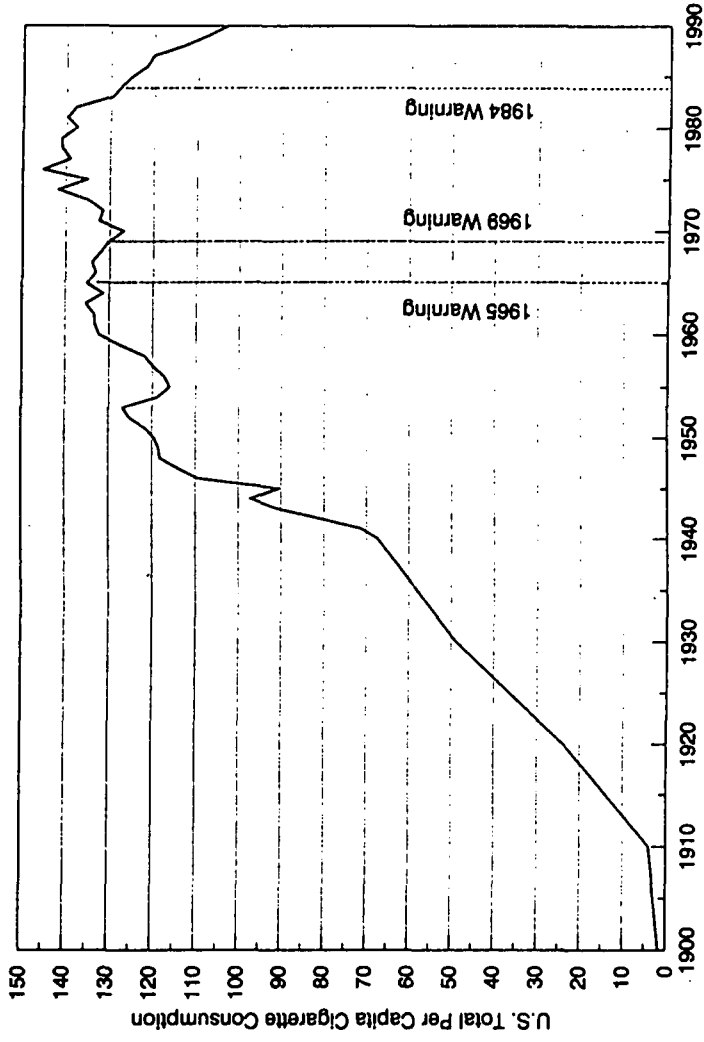

FIGURE 2

58. *See* VISCUSI, SMOKING, *supra* note 40, at 62-83.
59. *Id.* at 55-59.

The relationship between risk perceptions and smoking behavior is not conjecture. Using data on a large sample of smokers and nonsmokers, it was demonstrated that an increase in lung cancer risk perceptions had a substantial negative effect on an individual's propensity to smoke.[60] For example, if individuals believed the lung cancer risk from smoking had a probability of 0.05 rather than their current assessment of 0.42, then societal smoking rates would rise by 8%.[61] Thus there is a direct linkage between risk beliefs and the likelihood that an individual will choose to smoke. Hazard warnings can play a constructive role in that context to the extent that they can influence the risks that people assess with respect to smoking activity.

A similar result occurred in the case of saccharin warnings, which were introduced in 1978. Studies have shown that the introduction of these warnings had a substantial depressing effect on the sales of products containing saccharin.[62] One study, for example, found that diet soft drink sales grew at a faster rate before warnings were introduced then they did after the saccharin warnings went into effect.[63] In particular, the study suggested that the average annual growth rate in diet soft drink sales from 1975 to 1977 was 17.2%, and this rate declined to 1.8% by 1978.[64] A subsequent study concluded that the introduction of the saccharin warning label reduced the sales of diet soft drinks by 4% and media coverage of the risks of saccharin reduced sales by 17%.[65] Disentangling these influences is necessarily difficult since the introduction of a hazard warning through public policy in all likelihood would affect

60. *Id.* at 99-100.

61. *See id.* at 100.

62. *See* Robert G. Orwin et al., *Evaluating the Life Cycle of a Product Warning: Saccharin and Diet Soft Drinks*, 8 EVALUATION REV. 801 (1984) (documenting effects of saccharin warning labels on sale of diet soft drinks); Raymond E. Schucker et al., *The Impact of the Saccharin Warning Label on Sales of Diet Soft Drinks in Supermarkets*, 2 J. PUB. POL. & MKTG. 46 (1983) (summarizing the sales trends of diet and regular soft drinks).

63. Schucker, *supra* note 62, at 47.

64. *Id.*

65. Orwin, *supra* note 62, at 815.

the extent of media coverage given to the risk as well.[66]

Another example of the efficacy of warnings is the example of tetracycline. This prescription drug, which is still a recommended treatment for ailments such as lyme disease and Rocky Mountain spotted fever, has the adverse effect among children ages zero to eight of causing tooth staining. In particular, the drug affected the coloration of permanent teeth in children, thus causing a visual discoloration in their adult teeth. In 1963, pharmaceutical companies introduced a hazard warning for this tooth staining risk to alert physicians to the potential hazard.[67]

Figure 3[68] presents the number of initial and renewed physician prescriptions of tetracycline (i.e., mentions per 1,000 population) as a function of the year. The age zero-eight pattern indicates the tetracycline usage for the at risk group, and the age nine plus pattern indicates the tetracycline usage for the group that was not susceptible to the tooth staining risk. If the tooth staining warning had not been given, then one would expect the usage of tetracycline for the age zero-eight group to follow the same shape of the trajectory for the age nine plus group. Thus the age nine plus group curve shape serves as a reference point for how the drug should perform given the availability of other drugs on the market, as well as possible decreased efficacy of the drug. As can be seen, even for the age nine plus group, eventually the drug use did taper off around 1972. In the case of the at risk group, however, beginning in 1963 there was a sharp and steady decline in tetracycline usage. This dramatic shift certainly suggests that the hazard warning that was included in the patient package insert and is published in the Physician's Desk Reference[69] did in fact in-

66. *Id.* at 810.

67. The shift in hazard warnings can be ascertained by reviewing annual versions of THE PHYSICIAN'S DESK REFERENCE. *See also* W. KIP VISCUSI, REFORMING PRODUCTS LIABILITY 152 (1991) [hereinafter VISCUSI, REFORMING] (discussing the April 1963 introduction of warnings).

68. *See* VISCUSI, REFORMING, *supra* note 67, at 153.

69. The warning suggested in *The Physician's Desk Reference* read:

> THE USE OF DRUGS OF THE TETRACYCLINE CLASS DURING TOOTH DEVELOPMENT (LAST HALF OF PREGNANCY, INFANCY AND CHILDHOOD TO THE AGE OF 8 YEARS) MAY CAUSE PERMANENT DISCOLORATION OF THE TEETH (YEL-

fluence prescribing behavior.

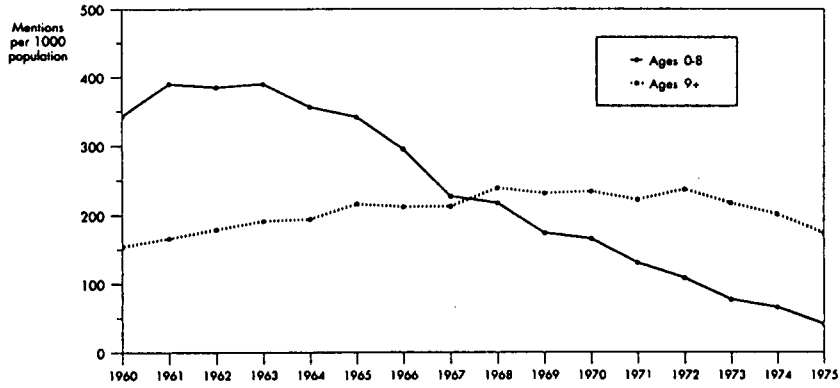

Figure 7.1. Use of tetracycline, 1960–1975, as measured by mentions (prescriptions and renewals)

FIGURE 3

It is also the case that not all doctors ceased prescribing tetracycline after the hazard warning. This result is not unexpected because tetracycline continues to be an effective treatment mode. Moreover, despite the risk of tooth staining, there may be other competing risks, such as threats to a patient's life. In addition, it may take time before doctors can develop and learn about alternative effective therapies and for new substitute drugs to become available on the market. Thus the response to hazard warning information is not always immediate as there may be some time lag before people can fully

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LOW-GRAY-BROWN). . . . TETRACYCLINE DRUGS, THEREFORE, SHOULD NOT BE USED IN THIS AGE GROUP UNLESS OTHER DRUGS ARE NOT LIKELY TO BE EFFECTIVE OR ARE CONTRAINDICATED.

THE PHYSICIAN'S DESK REFERENCE 1367 (50th ed. 1996).

adapt to the implications of this information. This lag does not imply that hazard warnings are ineffective, however, only that they are operating in a context in which other aspects of decisions, other than the warnings and the risk of the product itself, influence the actions of the public.[70] Indeed, in this instance since the decision maker was a learned intermediary, the physician, one would certainly expect a reasonably prompt response to the hazard warning information given the physician's extensive training in pharmacology.

Hazard warnings also affect the precautions consumers take with respect to products. Lawn mower warnings urge consumers not to put their hands or feet under the mower, and warnings for many prescription drugs alert consumers to the dangers of mixing the drugs with alcohol. Experimental evidence suggests that these types of warnings are potentially effective in alerting consumers to the presence of the risk and the need to take precautions.[71]

To assess the effect of hazard warning labels on precautionary behavior, consider the results for alternative labels for household bleach. Bleach is a particularly prominent hazard in that it accounts for a large share of adult poisonings.[72]

Table 8[73] presents alternative frequencies with which consumers would take different precautions. The columns in Table 8 report the percentage of the sample who would follow the desired precaution. The groups were stratified into different populations that were given alternative warning labels.[74] The

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70. *See generally* Barbara M. McGarey, Comment, *Pharmaceutical Manufacturers and Consumer-Directed Information Enhancing the Safety of Prescription Drug Use*, 34 CATH. U. L. REV. 153 (1984) (advocating multi-source communication system to improve consumer access to prescription drug information).

71. *See generally* MAGAT & VISCUSI, INFORMATIONAL APPROACHES, *supra* note 7, at 64.

72. A major risk of bleach is that if bleach is mixed with ammonia or ammonia-based products, chloramine gas will form.

73. *See* VISCUSI & MAGAT, LEARNING ABOUT RISK, *supra* note 7, at 66.

74. It should be emphasized that the fact that consumers observed a particular precaution, such as refraining from adding the product to ammonia based cleaners, does not necessarily indicate that they are exercising a concern for safety. Rather, they may not have simply considered this action for other reasons as well.

first column of statistics gives the results for the product for which no warning regarding the risks was provided. By comparing the results in this column with the columns for other warnings, it is possible to assess the incremental effect of the hazard warnings. The study first tested the label on Chlorox, which was the dominant national brand of bleach. The warnings on this product were sufficient to alert an additional 7% of consumers not to mix the product with toilet bowl cleaner and to lead an additional 20% to store the product in a childproof location. The next column gives the results for the Bright brand of bleach, the house brand for the Kroger food store chain. This warning label was particularly effective in alerting consumers not to mix bleach with toilet bowl cleaner, but it was less successful than the Chlorox label in leading consumers to store the product in a childproof location. The test label, which was restructured and reformatted to assist consumers in the processing of the information, had the strongest response to the precautions. The maximum incremental effect of warning labels appears in the final column of Table 8.

TABLE EIGHT: EFFECTS OF LABELS ON PRECAUTION-TAKING: BLEACH (PERCENTAGES)

PRECAUTION	*NO WARNING (n=51)*	*CLOROX (n=59)*	*BRIGHT (n=42)*	*TEST (n=44)*	*MAXIMUM INCREMENTAL EFFECT*
1. Do not mix with toilet bowl cleaner (if toilet is badly stained)	16	23	36	40	24
2. Do not add to ammonia-based cleaners (for particularly dirty jobs)	69	68	69	84	16
3. Store in childproof location	43	63	50	76	33

TABLE NINE: EFFECT OF WARNINGS ON PRECAUTIONS TAKEN WITH DRAIN OPENERS

PRECAUTION	*PERCENT OF SAMPLE TAKING PRECAUTION*			*MAXIMUM INCREMENTAL EFFECT (%)*
	DRANO/RED DEVIL LYE LABEL	*TEST LABEL*	*NO WARNING*	
Wear rubber gloves	82	73	63	19
Store in childproof location				
Households with children under five	90	83	70	20
Households with no children under five	63	61	48	15

Similar results appear in Table 9[75] for precautions with respect to drain openers. The specific product tested was a hybrid of Drano and Red Devil Lye. This label was considerably more effective than the test label or a label purged of warning information. Overall, the label was sufficient to lead 82% of respondents to want to wear rubber gloves when using the product and 90% of households with children under the age of five to store the product in a childproof location. These warning labels consequently had a strong effect on precautions. Nevertheless, presumably because of the consumers' intrinsic knowledge of the riskiness of this class of products — perhaps due in part to having received warning labels in the past — the level of precautions was already high even in the absence of specific warning information.

The failure of some consumers to take precautions does not necessarily indicate the ineffectiveness of hazard warnings. Considering the probabilities of the adverse events occurring and reasonable preferences regarding this risk, it might be quite reasonable for some people to choose not to wear rubber gloves because of the discomfort involved.[76] If it is desirable to

75. *See* VISCUSI, REFORMING, *supra* note 67, at 138.

76. The survey also listed information regarding the disutility of, for

compel such behavior rather than rely on decentralized decision making that is assisted with the aid of information, then the government should consider other regulatory strategies. In the case of very potent pesticides, for example, the U.S. Environmental Protection Agency requires that one become a certified pesticide applicator before using these pesticides.[77]

Due to cognitive limitations, the information format and structure are consequential, not simply the content. The importance of information structure is reflected in the previous results for bleach and drain opener. In each instance, with the exception of the no warning situation, the products contained the same risk information though it was structured and presented differently. The salience of the information and the manner in which it is presented do influence, at least to a degree, the ability of consumers to process the information.

Important dangers associated with hazard warnings are information overload and label clutter. If warnings are overly detailed, consumers will not be able to reliably process the information, thus impeding their ability to make informed decisions. The potential influence of label clutter is reflected in the three warning labels that appear in Figures 4a, 4b, and 4c. The baseline product in 4a is modeled after Ortho Malathion, a nationally marketed insect spray. The warning shown is in black and white, but the test warning used in the experimental study was in color.[78] Figure 4a is the reference point label that reflects label clutter. By deleting some of the risk information and increasing the print size for some of the warning information, Figure 4b facilitates consumer's ability to process the information. The final warning label shown in Figure 4c makes the warning information even bolder than before; the warnings box consumes an entire column of warning information.

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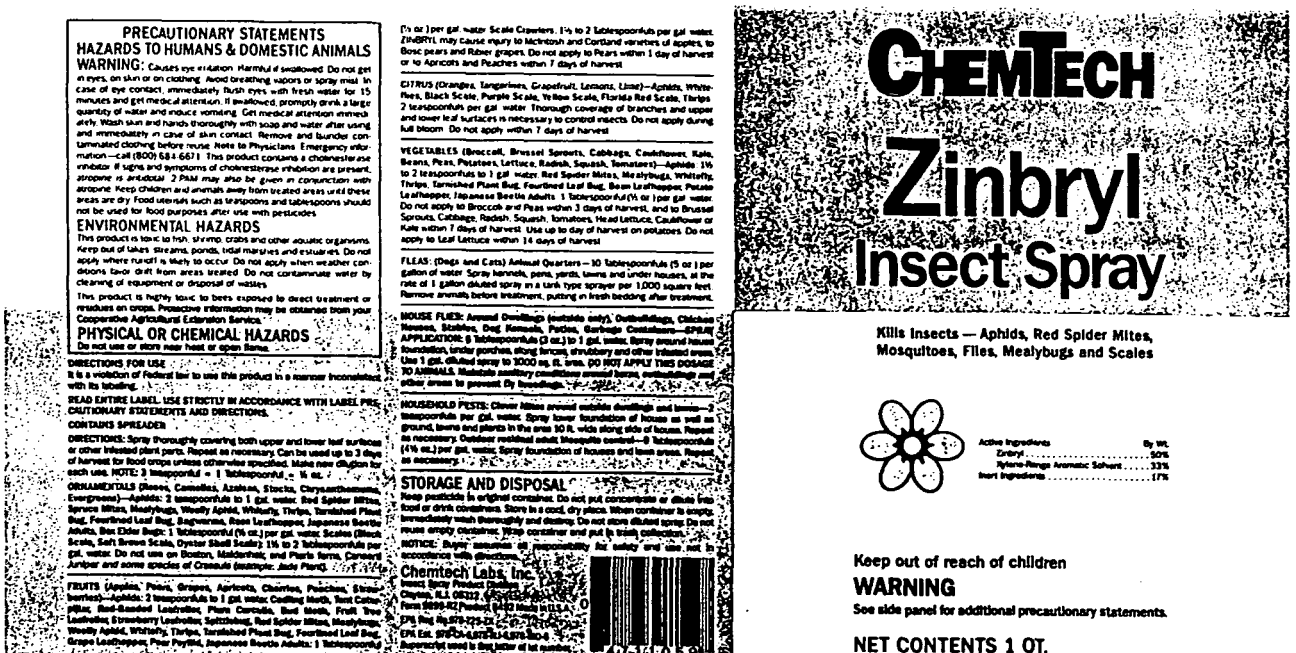
example, wearing rubber gloves.

77. *See* 7 U.S.C. § 136(a)(1) (1994) (requiring federal certification of state licensing programs issuing licenses to obtain restricted use pesticides).

78. For a description of the experimental results and documentation of many of the statements made here, see MAGAT & VISCUSI, INFORMATIONAL APPROACHES, *supra* note 7, at 27-43.



PRECAUTIONARY STATEMENTS
HAZARDS TO HUMANS & DOMESTIC ANIMALS
WARNING: Causes eye irritation. Harmful if swallowed. Do not get in eyes, on skin or on clothing. Avoid breathing vapors or spray mist. In case of eye contact, immediately flush eyes with fresh water for 15 minutes and get medical attention. If swallowed, promptly drink a large quantity of water and induce vomiting. Get medical attention immediately. Wash skin and hands thoroughly with soap and water after using and immediately in case of skin contact. Remove and launder contaminated clothing before reuse. Note to Physicians: Emergency information—call (800) 684-6671. This product contains a cholinesterase inhibitor. If signs and symptoms of cholinesterase inhibition are present, atropine is antidotal. 2 PAM may also be given in conjunction with atropine. Keep children and animals away from treated areas until these areas are dry. Food utensils such as teaspoons and tablespoons should not be used for food purposes after use with pesticides.

ENVIRONMENTAL HAZARDS
This product is toxic to fish, shrimp, crabs and other aquatic organisms. Keep out of lakes, streams, ponds, tidal marshes and estuaries. Do not apply where runoff is likely to occur. Do not apply when weather conditions favor drift from areas treated. Do not contaminate water by cleaning of equipment or disposal of wastes.

This product is highly toxic to bees exposed to direct treatment or residues on crops. Protective information may be obtained from your Cooperative Agricultural Extension Service.

PHYSICAL OR CHEMICAL HAZARDS
Do not use or store near heat or open flame.

DIRECTIONS FOR USE
It is a violation of Federal law to use this product in a manner inconsistent with its labeling.

READ ENTIRE LABEL. USE STRICTLY IN ACCORDANCE WITH LABEL PRECAUTIONARY STATEMENTS AND DIRECTIONS.

CONTAINS SPREADER

DIRECTIONS: Spray thoroughly covering both upper and lower leaf surfaces or other infested plant parts. Repeat as necessary. Can be used up to 3 days of harvest for food crops unless otherwise specified. Make new dilution for each use. NOTE: 3 teaspoonful = 1 Tablespoonful = ½ oz.

ORNAMENTALS (Roses, Camellias, Azaleas, Stocks, Chrysanthemums, Evergreens)—Aphids: 2 teaspoonfuls to 1 gal. water. Red Spider Mites, Spruce Mites, Mealybugs, Woolly Aphid, Whitefly, Thrips, Tarnished Plant Bug, Fourlined Leaf Bug, Bagworms, Rose Leafhopper, Japanese Beetle Adults, Box Elder Bugs: 1 Tablespoonful (½ oz.) per gal. water. Scales (Black Scale, Soft Brown Scale, Oyster Shell Scale): 1½ to 2 Tablespoonfuls per gal. water. Do not use on Boston, Maidenhair, and Pteris ferns, Cleyera, Juniper and some species of Crassula (example: Jade Plant).

FRUITS (Apples, Pears, Grapes, Apricots, Cherries, Peaches, Strawberries)—Aphids: 2 teaspoonfuls to 1 gal. water. Codling Moth, Tent Caterpillar, Red-Banded Leafroller, Plum Curculio, Bud Moth, Fruit Tree Leafroller, Strawberry Leafroller, Spittlebug, Red Spider Mites, Mealybugs, Woolly Aphid, Whitefly, Thrips, Tarnished Plant Bug, Fourlined Leaf Bug, Grape Leafhopper, Pear Psylla, Japanese Beetle Adults: 1 Tablespoonful (½ oz.) per gal. water. Scale Crawlers: 1½ to 2 Tablespoonfuls per gal. water. ZINBRYL may cause injury to McIntosh and Cortland varieties of apples, to Bosc pears and Ribier grapes. Do not apply to Pears within 1 day of harvest or to Apricots and Peaches within 7 days of harvest.

CITRUS (Oranges, Tangerines, Grapefruit, Lemons, Limes)—Aphids, Whiteflies, Black Scale, Purple Scale, Yellow Scale, Florida Red Scale, Thrips: 2 teaspoonfuls per gal. water. Thorough coverage of branches and upper and lower leaf surfaces is necessary to control insects. Do not apply during full bloom. Do not apply within 7 days of harvest.

VEGETABLES (Broccoli, Brussel Sprouts, Cabbage, Cauliflower, Kale, Beans, Peas, Potatoes, Lettuce, Radish, Squash, Tomatoes)—Aphids: 1½ to 2 teaspoonfuls to 1 gal. water. Red Spider Mites, Mealybugs, Whitefly, Thrips, Tarnished Plant Bug, Fourlined Leaf Bug, Bean Leafhopper, Potato Leafhopper, Japanese Beetle Adults: 1 Tablespoonful (½ oz.) per gal. water. Do not apply to Broccoli and Peas within 3 days of harvest, and to Brussel Sprouts, Cabbage, Radish, Squash, Tomatoes, Head Lettuce, Cauliflower or Kale within 7 days of harvest. Use up to day of harvest on potatoes. Do not apply to Leaf Lettuce within 14 days of harvest.

FLEAS: (Dogs and Cats) Aniseat Quarters—10 Tablespoonfuls (5 oz.) per gallon of water. Spray kennels, pens, yards, lawns and under houses, at the rate of 1 gallon diluted spray in a tank type sprayer per 1,000 square feet. Remove animals before treatment, putting in fresh bedding after treatment.

HOUSE FLIES: Around Dwellings (outside only), Outbuildings, Chicken Houses, Stables, Dog Kennels, Patios, Garbage Containers—SPRAY APPLICATION: 2 Tablespoonfuls (1 oz.) to 1 gal. water. Spray around house foundation, under porches, along fences, shrubbery and other infested areas. Use 1 gal. diluted spray to 1000 sq. ft. area. DO NOT APPLY THIS DOSAGE TO ANIMALS. Moderate sanitary conditions around barns, outbuildings and other areas to prevent fly breedings.

HOUSEHOLD PESTS: Clover Mites around exterior dwellings and homes—2 teaspoonfuls per gal. water. Spray lower foundation of house as well as ground, lawns and plants in the area 10 ft. wide along side of house. Repeat as necessary. Outdoor residual adult Mosquito control—8 Tablespoonfuls (4 oz.) per gal. water. Spray foundation of houses and lawn areas. Repeat as necessary.

STORAGE AND DISPOSAL
Keep pesticide in original container. Do not put concentrate or dilute into food or drink containers. Store in a cool, dry place. When container is empty, immediately wash thoroughly and destroy. Do not store diluted spray. Do not reuse empty container. Triple container and put in trash collection.

NOTICE: Buyer assumes all responsibility for safety and use not in accordance with directions.

Chemtech Labs, Inc.
Insect Spray Product Division
Clayton, R.I. 08222
Form 2899-R2 Product 9480 Made in U.S.A.
EPA Reg. No. 879-575-CX
EPA Est. 879-CA-1,879-RI-1,879-MA-1
Pyrethrins used in this batch of lot number

CHEMTECH
Zinbryl
Insect Spray

Kills Insects — Aphids, Red Spider Mites, Mosquitoes, Flies, Mealybugs and Scales

Active Ingredients	By Wt.
Zinbryl	50%
Xylene-Range Aromatic Solvent	33%
Inert Ingredients	17%

Keep out of reach of children
WARNING
See side panel for additional precautionary statements.

NET CONTENTS 1 QT.

FIGURE 4a

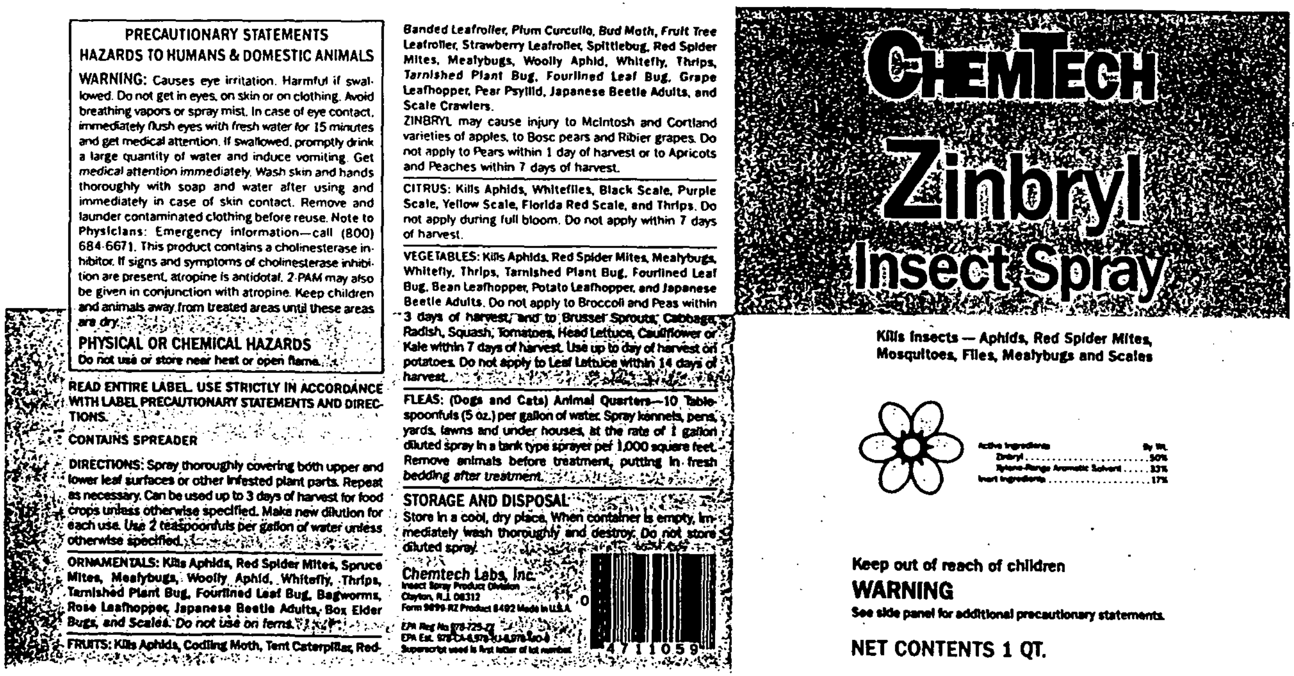
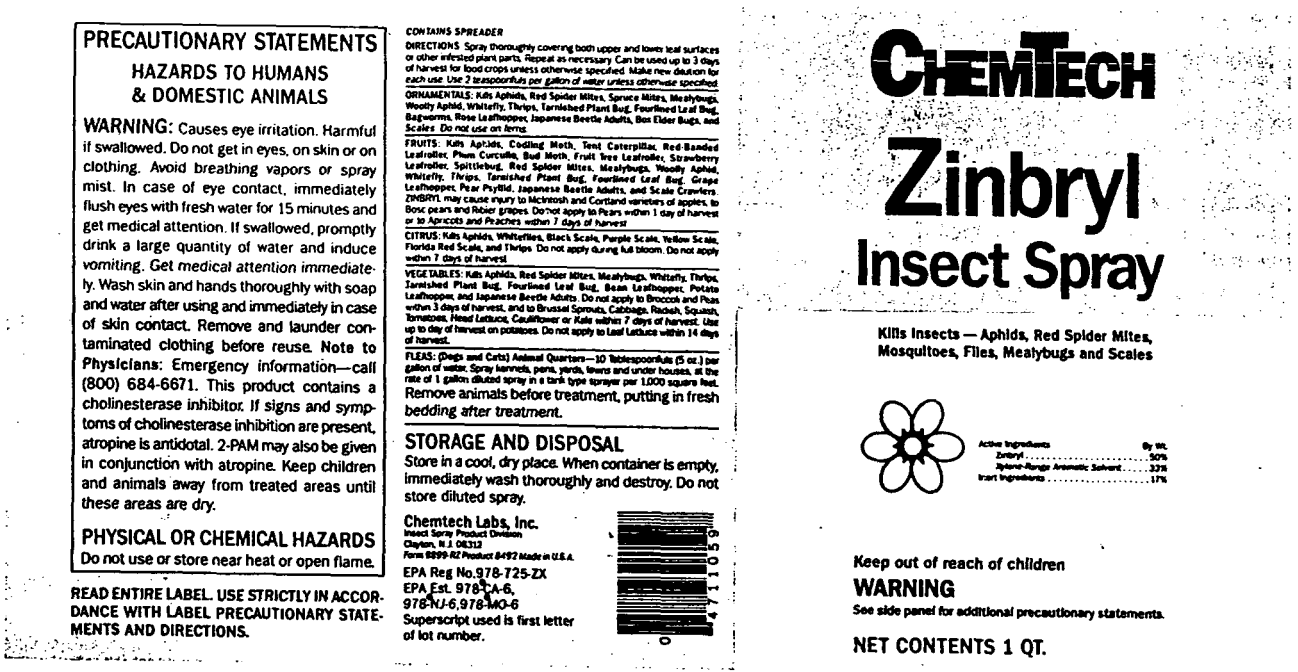

PRECAUTIONARY STATEMENTS
HAZARDS TO HUMANS & DOMESTIC ANIMALS
WARNING: Causes eye irritation. Harmful if swallowed. Do not get in eyes, on skin or on clothing. Avoid breathing vapors or spray mist. In case of eye contact, immediately flush eyes with fresh water for 15 minutes and get medical attention. If swallowed, promptly drink a large quantity of water and induce vomiting. Get medical attention immediately. Wash skin and hands thoroughly with soap and water after using and immediately in case of skin contact. Remove and launder contaminated clothing before reuse. Note to Physicians: Emergency information—call (800) 684-6671. This product contains a cholinesterase inhibitor. If signs and symptoms of cholinesterase inhibition are present, atropine is antidotal. 2-PAM may also be given in conjunction with atropine. Keep children and animals away from treated areas until these areas are dry.
PHYSICAL OR CHEMICAL HAZARDS
Do not use or store near heat or open flame.
READ ENTIRE LABEL. USE STRICTLY IN ACCORDANCE WITH LABEL PRECAUTIONARY STATEMENTS AND DIRECTIONS.
CONTAINS SPREADER
DIRECTIONS: Spray thoroughly covering both upper and lower leaf surfaces or other infested plant parts. Repeat as necessary. Can be used up to 3 days of harvest for food crops unless otherwise specified. Make new dilution for each use. Use 2 teaspoonfuls per gallon of water unless otherwise specified.
ORNAMENTALS: Kills Aphids, Red Spider Mites, Spruce Mites, Mealybugs, Woolly Aphid, Whitefly, Thrips, Tarnished Plant Bug, Fourlined Leaf Bug, Bagworms, Rose Leafhopper, Japanese Beetle Adults, Box Elder Bugs, and Scales. Do not use on ferns.
FRUITS: Kills Aphids, Codling Moth, Tent Caterpillar, Red-Banded Leafroller, Plum Curculio, Bud Moth, Fruit Tree Leafroller, Strawberry Leafroller, Spittlebug, Red Spider Mites, Mealybugs, Woolly Aphid, Whitefly, Thrips, Tarnished Plant Bug, Fourlined Leaf Bug, Grape Leafhopper, Pear Psyllid, Japanese Beetle Adults, and Scale Crawlers.
ZINBRYL may cause injury to McIntosh and Cortland varieties of apples, to Bosc pears and Ribier grapes. Do not apply to Pears within 1 day of harvest or to Apricots and Peaches within 7 days of harvest.
CITRUS: Kills Aphids, Whiteflies, Black Scale, Purple Scale, Yellow Scale, Florida Red Scale, and Thrips. Do not apply during full bloom. Do not apply within 7 days of harvest.
VEGETABLES: Kills Aphids, Red Spider Mites, Mealybugs, Whitefly, Thrips, Tarnished Plant Bug, Fourlined Leaf Bug, Bean Leafhopper, Potato Leafhopper, and Japanese Beetle Adults. Do not apply to Broccoli and Peas within 3 days of harvest, and to Brussel Sprouts, Cabbage, Radish, Squash, Tomatoes, Head Lettuce, Cauliflower or Kale within 7 days of harvest. Use up to day of harvest on potatoes. Do not apply to Leaf Lettuce within 14 days of harvest.
FLEAS: (Dogs and Cats) Animal Quarters—10 Tablespoonfuls (5 oz.) per gallon of water. Spray kennels, pens, yards, lawns and under houses, at the rate of 1 gallon diluted spray in a tank type sprayer per 1,000 square feet. Remove animals before treatment, putting in fresh bedding after treatment.
STORAGE AND DISPOSAL
Store in a cool, dry place. When container is empty, immediately wash thoroughly and destroy. Do not store diluted spray.
Chemtech Labs, Inc.
CHEMTECH
Zinbryl
Insect Spray
Kills Insects — Aphids, Red Spider Mites, Mosquitoes, Flies, Mealybugs and Scales
Keep out of reach of children
WARNING
See side panel for additional precautionary statements.
NET CONTENTS 1 QT.

FIGURE 4b



PRECAUTIONARY STATEMENTS

HAZARDS TO HUMANS & DOMESTIC ANIMALS

WARNING: Causes eye irritation. Harmful if swallowed. Do not get in eyes, on skin or on clothing. Avoid breathing vapors or spray mist. In case of eye contact, immediately flush eyes with fresh water for 15 minutes and get medical attention. If swallowed, promptly drink a large quantity of water and induce vomiting. Get medical attention immediately. Wash skin and hands thoroughly with soap and water after using and immediately in case of skin contact. Remove and launder contaminated clothing before reuse. **Note to Physicians:** Emergency information—call (800) 684-6671. This product contains a cholinesterase inhibitor. If signs and symptoms of cholinesterase inhibition are present, atropine is antidotal. 2-PAM may also be given in conjunction with atropine. Keep children and animals away from treated areas until these areas are dry.

PHYSICAL OR CHEMICAL HAZARDS

Do not use or store near heat or open flame.

READ ENTIRE LABEL. USE STRICTLY IN ACCORDANCE WITH LABEL PRECAUTIONARY STATEMENTS AND DIRECTIONS.

CONTAINS SPREADER

DIRECTIONS Spray thoroughly covering both upper and lower leaf surfaces or other infested plant parts. Repeat as necessary. Can be used up to 3 days of harvest for food crops unless otherwise specified. Make new dilution for each use. *Use 2 teaspoonfuls per gallon of water unless otherwise specified.*

ORNAMENTALS: Kills Aphids, Red Spider Mites, Spruce Mites, Mealybugs, Woolly Aphid, Whitefly, Thrips, Tarnished Plant Bug, Fourlined Leaf Bug, Bagworms, Rose Leafhopper, Japanese Beetle Adults, Box Elder Bugs, and Scales. *Do not use on ferns.*

FRUITS: Kills Aphids, Codling Moth, Tent Caterpillar, Red-Banded Leafroller, Plum Curculio, Bud Moth, Fruit Tree Leafroller, Strawberry Leafroller, Spittlebug, Red Spider Mites, Mealybugs, Woolly Aphid, Whitefly, Thrips, Tarnished Plant Bug, Fourlined Leaf Bug, Grape Leafhopper, Pear Psyllid, Japanese Beetle Adults, and Scale Crawlers. ZINBRYL may cause injury to McIntosh and Cortland varieties of apples, to Bosc pears and Rober grapes. Do not Apply to Pears within 1 day of harvest or to Apricots and Peaches within 7 days of harvest.

CITRUS: Kills Aphids, Whiteflies, Black Scale, Purple Scale, Yellow Scale, Florida Red Scale, and Thrips. Do not apply during full bloom. Do not apply within 7 days of harvest.

VEGETABLES: Kills Aphids, Red Spider Mites, Mealybugs, Whitefly, Thrips, Tarnished Plant Bug, Fourlined Leaf Bug, Bean Leafhopper, Potato Leafhopper, and Japanese Beetle Adults. Do not apply to Broccoli and Peas within 3 days of harvest, and to Brussel Sprouts, Cabbage, Radish, Squash, Tomatoes, Head Lettuce, Cauliflower or Kale within 7 days of harvest. Use up to day of harvest on potatoes. Do not apply to Leaf Lettuce within 14 days of harvest.

FLEAS: (Dogs and Cats) Animal Quarters—10 Tablespoonfuls (5 oz.) per gallon of water. Spray kennels, pens, yards, lawns and under houses, at the rate of 1 gallon diluted spray in a tank type sprayer per 1,000 square feet. Remove animals before treatment, putting in fresh bedding after treatment.

STORAGE AND DISPOSAL

Store in a cool, dry place. When container is empty, immediately wash thoroughly and destroy. Do not store diluted spray.

Chemtech Labs, Inc.
Insect Spray Product Division
Clayton, N.J. 08312
Form 8899-RZ Product 8492 Made in U.S.A.

EPA Reg No.978-725-ZX
EPA Est. 978-CA-6, 978-NJ-6,978-MO-6
Superscript used is first letter of lot number.

CHEMTECH

Zinbryl

Insect Spray

Kills Insects — Aphids, Red Spider Mites, Mosquitoes, Flies, Mealybugs and Scales

Active Ingredients	By Wt.
Zinbryl	50%
Xylene-Range Aromatic Solvent	33%
Inert Ingredients	17%

Keep out of reach of children

WARNING

See side panel for additional precautionary statements.

NET CONTENTS 1 QT.

FIGURE 4c

The studies on this product, as well as a similar study on toilet bowl cleaner, led to several conclusions. Label clutter is an impediment to consumers' ability to process the warning information. When inundated with a variety of hazard warnings such as on the cluttered label in Figure 4a, consumers generally grasp the notion that the product is risky, but are less able to distinguish the degree of risks and precautions needed because of the extensive information they have been provided. Improving the clarity of the risk information and pruning the label of some of the extraneous information, as demonstrated in Figure 4b, is a desirable modification that assists consumers in information processing. Such improvements, however, do have a diminishing effect on consumers' ability to process warning information. The enlarged type used in Figure 4c, as well as similar manipulations for other products, do not confer a significant incremental benefit. Thus, the major task of warning labels is to restrict the information to a reasonable degree and to present it in a clear and easily processed manner. Once this level of clarity has been achieved, additional nuances such as bolder boxing, larger print size, and similar manipulations do not have consequential influence on the efficacy of the warning. Consumers generally face a situation of information overload. Product warning labels are proliferating, and, as was reflected in the insecticide label, the verbiage on the warnings is increasing as well. What are the incentives that have led to this situation?

First, from the standpoint of label proliferation, the difficulty is that no individual producer has the incentive to think about how the addition of one warning label will dilute the efficacy of other warnings by adding to the number of warnings that consumers must process. The more products that include such warnings, the more warnings are diluted for other products. Similarly, regulatory and liability pressures lead firms to make their warnings as comprehensive as possible. The result is that there is a potential danger of information overload from the increase in the amount of information and the diversity of risks included in the warning.

Excessive warnings are not innocuous. If warnings indicate a high relative risk when there is none, they will distort relative product comparisons, thus compromising credibility. Similarly, if warnings are included for inconsequential risks, they

will serve to further dilute the warnings for the real hazards that should be identified to consumers.

The problems associated with information formatting can be alleviated to some extent through the use of a common format and structure. One possibility is to adopt a uniform hazard warnings vocabulary.[79] Of the Federal warnings efforts, the Food and Drug Administration warnings for prescription drugs is perhaps the best model. That warning system includes a common format for all warnings for directions, contraindications, and other information. The information appears in a consistent manner across all warning labels. Moreover, because all warnings are drafted in large part by the Food and Drug Administration and in all cases are specifically approved by them, the agency can ensure that there is a consistent warnings vocabulary across hazard warning labels. Consequently, the use of bold type or of the boxing of warnings and similar nuances can be undertaken in a manner that truly reflects the relative risk.

The introduction of a hazard warnings vocabulary as a reference point could serve to alleviate many of the problems associated with warnings. At the present time, companies have no safe harbor with respect to warnings. Because there is no regulatory compliance defense and no generally accepted hazard warnings vocabulary, companies may have the incentive to overwarn in order to avert potential liability costs. This incentive for overwarning is augmented by the asymmetry in the court created penalties; companies are penalized for underwarning but not for overwarning. The establishment of a uniform vocabulary coupled with a regulatory compliance defense for warnings that adhere to this vocabulary would ensure that firms could warn consistently across product lines and that the warning language that was selected would have a consistent meaning to the consumers who process the information.

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79. *See* AMERICAN LAW INSTITUTE, ENTERPRISE RESPONSIBILITY FOR PERSONAL INJURY (1991); VISCUSI, REFORMING, *supra* note 67, at 155-56 (proposing a national warnings policy for a national vocabulary for warnings to bolster the regulatory compliance defense).

6. *IMPLICATIONS OF FAILURES FOR WARNING DESIGN*

Hazard warnings policy should reflect the role of cognitive limitations in consumer processing of warning information. In particular, consumers should not be overloaded with extraneous information; the necessary information should be formatted in a manner that can be readily processed. In addition, hazard warnings should provide new information in a clear and consistent manner without attempting to simply persuade consumers into changing their views or preferences.

Even with an effective warnings policy, 100% effectiveness is unlikely to alter behavior in the desired manner. For some percentage of the consumers, the desired action will simply not be rational, as in the case of consumers who choose not to wear rubber gloves while using a caustic drain opener. Another group of consumers will not receive the warning message, and for others the warning message will not alter their actions because they do not process the message reliably.

How then should we assess the desirability of warnings as compared with other more direct interventions, such as either government regulation or tort liability? The approach here will be to adopt an appropriately specified risk-utility analysis, in effect a benefit-cost test.[80] The benefit of hazard warnings is to improve consumer decisions, fostering appropriate precautions and minimizing risk taking activities. The costs associated with warnings include not only the direct informational costs, but also the costs associated with needless precautions and excessive warnings that lead consumers to avoid non-risky behaviors. A similar analysis could be applied for the desirability of additional safety devices.

The critical issue is not so much how one thinks about the test, but rather the reference point used. Should we, for example, focus on the worst case scenario — the consumers who will either not receive the warning message or will not act in a sensible manner? If that is our reference point, then very strong interventionist measures will be desirable.

The reference point used here will be somewhat different.

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80. I have elaborated on this test earlier in VISCUSI, REFORMING, *supra* note 67. Essentially, it avoids the overlaps of Wade's risk utility test and eliminates the insurance objective. *See* Wade, *infra* note 82.

The audience for mass produced consumer products is not a single flawed individual but rather the entire marketplace, including both consumers who do and do not behave rationally. Given this mix of individuals, what policy, either in terms of hazard warnings or safety devices, will produce the greatest net benefit to society? More specifically, how can we maximize the difference between the benefits and the costs associated with these actions? In general, while there will be some percentage of failures in the population, we cannot target our interventions to those specific people. Instead, we should ask whether the warnings pass muster for the entire market and, if so, then warnings should remain the desired policy approach even though direct control of the product risk characteristics might protect the small segment of consumers who do not make sound decisions.

The decision to switch to a regime in which the product risk characteristics are directly controlled should not be a casual one. Warnings take advantage of the heterogeneity of individual responses to risk and enable people to make choices consistent with their own preferences. Once we move to a situation in which uniform safety characteristics are instituted across the entire market, this heterogeneity is no longer expressed. Thus one must assess whether the benefits from avoiding mistaken decisions achieved through mandating safety characteristics are sufficient to offset the welfare loss incurred both through the additional cost of providing the safety as well as by the elimination of choices in the marketplace. Once again, the most desirable policy depends on which yields the greatest net benefit to society.

Although undertaking risk-utility tests of various kinds may cause serious implementation problems for the courts, using them for general analysis should pose less difficulty, especially when it is unnecessary to actually explore these issues in detail. For instance, in situations where companies have complied with explicit government safety regulations that ensure that an efficient level of safety has been provided (i.e., a level of safety such that if higher safety levels were required the costs of doing so would exceed the benefits), those firms should be given credit for fulfilling their safety obligations. A prominent example offering a rationale for a strong regulatory compliance defense would be the FDA's requirement for prescrip-

tion drugs. In addition to basically dictating the warning language, the FDA's very elaborate premarket approval program ensures the safety and efficacy of these products to the highest level possible based on the information available. Unless there is evidence of fraud or withholding of information from the regulatory agency, courts have little rationale for second guessing these regulatory decisions.[81]

7. *THE IRRELEVANCE OF INSURANCE MARKET FAILURES*

The standard rationale explaining both the need for strict liability and the failure of hazard warnings is that insurance markets do not function adequately. Insurance has long played a central role behind the strict liability regime and has therefore been incorporated into the risk-utility test specified by Dean Wade.[82] Although this insurance rationale is feasible in cases of isolated manufacturing defects, it makes little sense in the world of modern tort liability.

This insurance rationale assumes producers can spread the costs of insurance across product lines, thereby reducing the average cost to any particular product. With the advent of design defect and hazard warnings cases which affect an entire product line, it is no longer feasible to spread the costs among a large group because instead of having independent and identically distributed risks for each product, the risks are correlated across the products. Accordingly, firms are hit with waves of liability rather than isolated events that are well suited for insurance coverage.

An additional difficulty arises with respect to retroactive liability. Consumers will pay for insurance associated with products only if this insurance is purchased on a prospective basis.[83] In the situation of retroactive liability, firms will not

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81. For a fuller advocacy of the regulatory compliance defence, see W. Kip Viscusi et al., *Deterring Inefficient Pharmaceutical Litigation: An Economic Rationale for the FDA Regulatory Compliance Defense*, 24 SETON HALL L. REV. 1437, 1463-67 (1994).

82. J. Wade, *On the Nature of Strict Tort Liability for Products*, 44 MISS. L.J. 825, 837-38 (1973).

83. It should also be noted that this insurance must be valued by consumers. If consumers already have purchased private insurance coverage, then additional insurance that duplicates this coverage will be less desir-

be able to pass on these costs to future generations of purchasers of the product, because while consumers may be willing to pay for present or future product costs, they may be unwilling to pay for benefits already received by others. Firms attempting to recoup these historic liability costs will be undercut by new entrants to the market who, with lower costs, have correspondingly lower prices.

This basic difficulty creates a problem for unanticipated risks, such as changes in tort liability. In such situations, producers are not in a position to incorporate an insurance contract into the bundle of product characteristics.

Mass toxic torts, such as those associated with inadequate asbestos warnings, also do not fit the insurance regime. The costs associated with asbestos suits exceeded both insurance and manufacturer resources.[84] Part of the problem stemmed from insurance companies who consistently underestimated the loss, therefore undercharging premiums. Lloyds of London, the famed insurer that covers risks ranging from pianists hands to basketball player Grant Hill, estimated that there would be 80,000 asbestos claims in 1980, but by 1990 raised this estimate to 180,000 claims.[85] Breast implants, the Dalkon Shield, and DES are similar in character. Large scale losses could not be handled by producers in the same manner as hypothesized for isolated manufacturing defects. Consequently, when formulating the risk-utility test - or some variate of it - to judge either hazard warnings or changes in product characteristics, both the legitimate insurance difficulties and the often infeasible insurance objective of tort liability must be recognized.

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able.

84. *See, e.g.*, Barnaby J. Feder, *Asbestos: The Saga Drags On*, N.Y. TIMES, Apr. 2, 1989, at C1 (discussing companies driven into bankruptcy as a result of asbestos litigation).

85. *See* Nick Sinfield, Asbestos - Human or Natural Disaster?, Address Before the Stanford University Conference on Social Treatment of Catastrophic Risk (1994).

8. *CRITERIA FOR LIABILITY REFORM*

The presumption of a totally irrational consumer is simply not warranted, despite the existence of cognitive limitations. For example, people can seldom process more than five to seven pieces of information. Notwithstanding the influence of these cognitive limitations, it is not correct to draw the simplistic conclusion that risks are always underestimated. Risk perceptions are not always accurate, but underestimation is not the norm. Indeed, for very small risks, there is a consistent pattern of overestimation of the hazards.[86]

The introduction of a uniform hazard warnings vocabulary would also assist in the design of consistent warnings across products, facilitate information processing and provide courts with a standardized test of warning sufficiency. At present, companies may have an excessive incentive for overwarning because tort liability penalizes firms for underwarning but not for overwarning. Coupling this tort uncertainty with the absence of a safe harbor may lead to excessive hazard warnings.

A market based analysis should be used before a move from hazard warnings to a more stringent form of intervention, such as direct control of product risk characteristics. While there will always be some percentage of consumers who either do not receive or do not act sensibly upon the message, the existence of some failures does not indicate a worst case scenario. In addition, a market based perspective should reflect the scope of decisions made by the firm. Ultimately, the question becomes whether warnings make sense for the broad range of preferences reflected in the market, or whether standardization of the safety level is preferable. These issues can be resolved through properly formulated risk-utility tests, uncontaminated by the unspecified insurance objectives of tort liability. The current system is infeasible and is based upon a misunderstanding of how insurance markets work.

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86. *See* W. Kip Viscusi & O'Connor, *supra* note 51, at 59 (1985) (noting that a "widely cited result in the risk perception literature is that individuals assessing risks of fatality overassess the risks of low probability events (e.g., smallpox and botulism) and underassess the risks of high probability events (e.g., diabetes and stroke)").