Cognitive Considerations in Designing Effective Labels for Presenting Risk Information

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A brief review of how people process information when thinking about risk is provided and general propositions are developed. These propositions lead to a set of general guidelines for designing labels for presenting risk information. Specific labels for cleaning agents and drain openers are presented as examples of these guidelines.

Over the last two decades, consumers have shown a greater concern for the daily risks they encounter. Nuclear power, toxic wastes, and even common consumer products (e.g., drain cleaners, lawn mowers, insecticides) have been viewed as potential hazards. Often the task of protecting the consumer from such hazards has been assigned to government agencies. The spectrum of potential regulation approaches used by these agencies varies from the one extreme of banning the potentially hazardous product, to the less restrictive approach of requiring firms to supply potential consumers with relevant use and hazard information, to the free market approach of removing any existing restraints [Mazis, Staelin, Beales, and Salop 1981]. In this paper we will deal almost exclusively with the middle approach, i.e., that of providing information to consumers.

There are three potential benefits associated with providing consumer information: improved decision making, enhanced product quality, and reduced prices [Mazis, Staelin, Beales, and Salop 1981]. The first benefit, better consumer choice, is almost self-evident since consumers armed with more complete information should be able to make better decisions than when their choice is based on limited knowledge about product attributes.

The second benefit, improved product quality, occurs whenever new information about an attribute causes some consumers to alter their choices so as to get more of the featured attribute. This change in the consumers' purchasing habits in turn signals sellers to alter their products to include more of this valued attribute. For example, if one brand is able to do the same job as other brands in a product class without exposing users to as great a risk, information about the risk differences across brands should ultimately cause all sellers to alter the make-up of their brands. As a result, the entire product class evolves into one which is less risky.

The third benefit, lower prices, often occurs when the new information facilitates product comparisons, thereby encouraging competition. This benefit, like the two above, can not be realized, however, unless the consumers understand the information and alter their decision patterns.

There are two basic assumptions which underlie information provision programs. The first is that, all else being equal, it is better to provide information than to ban the potentially hazardous product, since the first
choice imposes lower costs on society. Lower costs come about because risk preferences vary considerably across the population. Therefore, some consumers will prefer to purchase and use a risky product if they perceive that the product’s benefits outweigh its potential hazards. Banning places a cost on this group of consumers. Second, information provision programs place fewer constraints on the individual’s freedom to assume or reject risks than does banning the product from the marketplace [Mazis, Staelin, Beales and Salop 1981].

Although the design of an information provision program may appear to be straightforward, designing an effective program is not an easy task. Not only does one have to be concerned with the content of the information, but also with its format. There is extensive evidence from both basic and applied research that the same information presented in different formats can result in different decisions [for reviews, see Bettman 1979, Payne 1982, Winett and Kagel 1984]. For example, in the case of consumer choices among supermarket products, Russo [1977] has shown that very simple changes in the organization of unit price information at the point of purchase result in shifts in purchasing patterns, such that the average amount spent on a product class was reduced by 11 percent of the maximum possible savings. Such findings make it essential that those responsible for the design of an information provision program have a thorough understanding of the cognitive processes which the intended audience goes through when they attend to and evaluate the information. In addition, by understanding how consumers process information, designers can predict more accurately the effects of a particular format. Similar concerns arise for workplace hazards, but for concreteness we will focus on consumer decisions.

Figures 1 and 2 show two currently available bleach labels which use quite different formats to convey approximately the same safety and use information. We encourage the reader to look carefully at these two labels. Does one of these have a better format? Does it make any difference in behavior? If so, which format is best? Why? Are there any generalizable principles which can be put forward that would help one decide if one of the two label formats should be adopted as a standard? Is there a better label format? To help answer these questions, we next review what is known about how people process information when thinking about risks. Some specific answers to the above questions are provided later in the paper.

Thinking about Risk: Human Processing Limitations

There are numerous studies showing that people have difficulty coping with risk and uncertainty and some of these difficulties are briefly reviewed below. Many can be traced to general limitations in the way people process information. Consequently, we then provide an overview of the human as an information processor and decision maker. Much of this work emphasizes bounds on people’s abilities to make rational decisions about risks and benefits. While this bounded rationality does not necessarily reduce the need for information provision programs, it does increase the need to be careful in designing programs to inform people about risks.

Perceptions of Risk

One question of great concern in designing such programs is the ability of people to accurately perceive the risks they face. Unfortunately, it now appears that people’s perceptions of risks are often inaccurate [Slovic, Fischhoff, and Lichtenstein 1982]. Certain types of risks tend to be overestimated (e.g., death by homicide, cancer, and floods), while other
WHAT HOUSEHOLD CLEANING JOBS CAN CLOROX® DO?

Use Clorox to clean your bathroom and kitchen. Clorox is an excellent disinfectant and deodorizer, yet economical to use. Clorox cleans by removing stubborn stains and eliminating germ-caused odors from surfaces all around the house.

HOW MUCH CLOROX® SHOULD YOU USE?

For the best cleaning results, you should always use the proper amount of Clorox in the water. The guideline below should provide excellent cleaning results with any good soap or detergent. However, if you are using severe stains or strong odors, you may want to add slightly more Clorox.

- Regular top loading automatic: 1 1/2 cups
- Front loading automatic: 1 1/2 cups
- Heavy, speed, or high-speed: 2 cups
- Hand washing: 2 cups

WHAT FABRICS CAN YOU CLOROX®?

Cotton, linen, synthetics, permanent press and most colored fabrics can be safely bleached. You can test any fabric to determine if it is bleach safe by applying one drop of a 3% solution (3 parts per million) of Clorox to a hidden part of the fabric. If you do not see any discoloration, the fabric can be bleached. If the fabric bleaches, the fabric can be bleached. If the fabric does not bleach, it cannot be bleached.

YOUR LAUNDRY NEEDS CLOROX® BLEACH.

For the broad range of laundry problems you encounter, no other type of additive with your detergent can give a cleaner, brighter wash. And Clorox disinfects, too.

BLEACH CAUTION: KEEP OUT OF REACH OF CHILDREN (See Facts Panel for other cautions.)

BLEACH DISINFECTS REMOVES STAINS

0.95 LITER 0.5 QUART 1/2 LITERS

Clorox may be harmful if swallowed or may cause severe irritation if splashed in eyes.

Let hand-towels dry well. If not well-covered area. If clothes remain wet, they may remain wet. If exposed, contact with skin, wash off with water. Do not use Clorox with ammonia or products containing ammonia, such as toilet bowl cleaners, rust removers, or varnish. Do not use this bottle for storage of any other liquid but Clorox.

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Figure 2. Bright Bleach Label

### Bright Bleach

**CONTAINS NO PHOSPHORUS**

**WARN**ING: NOT FOR PERSONAL USE. DO NOT GET ON SKIN OR IN EYES. DO NOT TAKE INTERNALLY. IF SPLASHED IN EYES OR ON SKIN, FLOOD WITH WARM WATER 10-15 MINUTES. IF IRRITATION PERSISTS, CALL PHYSICIAN. IF SWALLOWED, GIVE MILK OR BREAD SOAKED IN MILK FOLLOWED BY COOKING OIL. CALL PHYSICIAN. KEEP OUT OF REACH OF CHILDREN.

**IMPORTANT:** Do not use chlorine bleach in combination with ammonia or other household chemicals, toilet bowl cleaners, rust removers, etc., since such mixing occurs, hazardous gases may be released. Avoid transfer to food or beverage containers. Avoid contamination of food. KEEP UPRIGHT IN A COOL PLACE.

**TEST FOR BLEACHABILITY:** To test a colored fabric, wash and wear cottons and rayons, or a fabric of unknown composition for bleachability, apply a mixture of 1 tablespoon of bleach in a gallon hot water to an inconspicuous corner and let stand for 3-5 minutes. If fabric color fades or yellows, it is not bleachable.

<table>
<thead>
<tr>
<th>PURPOSE</th>
<th>AMOUNT</th>
<th>DIRECTIONS</th>
</tr>
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<tbody>
<tr>
<td>Laundering: To bleach white and colored cotton, linens, jeans, denim, silk, and rayon in washing machines</td>
<td>1 cup BRIGHT bleach per load for conventional washing machine</td>
<td>Add to pre-wash, wash water or first rinse if clothes are in machine, dilute bleach in 1 quart water before adding</td>
</tr>
<tr>
<td>To Whiten &quot;AGE YELLOWED&quot; WOOL</td>
<td>1 tablespoon BRIGHT bleach per gallon water</td>
<td>Soak clean fabric in solution for 15 to 20 minutes. Rinse well. Repeat if necessary</td>
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<tr>
<td>To Remove Stains: Fruit, berry, wine, coffee, ink, grass, shoe, medicine stains, etc.</td>
<td>Make a solution of 2 tablespoons BRIGHT bleach per gallon water</td>
<td>Immers fabric for 5 to 10 minutes. Rinse well in clear water. Repeat if necessary</td>
</tr>
<tr>
<td>To Clean Kitchen and Bathroom: Refrigerator, ice, bathtub, etc.</td>
<td>2 tablespoons BRIGHT bleach to 1 quart of water</td>
<td>Wash, rinse and dry. Do not use on silverware</td>
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**WARNING:** WILL IRRITATE SKIN & EYES. HARMFUL IF SWALLOWED. (SEE BACK PANEL FOR ADDITIONAL PRECAUTIONS) KEEP OUT OF REACH OF CHILDREN.
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types of risks tend to be underestimated (e.g., death due to diabetes). Slovic, Fischhoff, and Lichtenstein suggest that perceptions of risk are determined, at least in part, by how easily a person can imagine or recall instances of that risk. Such a process for judging risks, often referred to as availability, is valid in most instances, since more frequent events will generally be easier to recall, or their potential occurrence will be easier to imagine. However, ease of recall and imagination are related to factors other than just the statistical frequency with which events occur. For example, the same types of dramatic or sensational causes of death that people generally overestimate are those accidents that are heavily reported in the news media [Combs and Slovic 1976]. Thus people are sometimes misled to perceive the wrong risks associated with an item.

There is also evidence that when individuals forecast certain natural hazards, e.g., floods, they are strongly conditioned by their immediate past [Kates 1982]. That is, if an event has not happened recently, it is seen as not very likely to occur in the future. This reliance on personal experience may be particularly great for familiar hazards that are to some extent under the individual’s control [Slovic, Fischhoff, and Lichtenstein 1980]. For example, consider a household’s use of toxic chemicals such as bleach. Unless the potential risks of such products are made vivid, people are likely to underestimate them, since the easiest to recall situations are those where the product causes no harm.

Such an example is compatible with the finding that people have a tendency to consider themselves relatively immune to common hazards [Rethans 1979; Svenson 1979, cited in Slovic et al. 1980]. For example, most people believe themselves to be better than average drivers, and the vast majority of people judge their ability to avoid accidents with common products to be average or above average.

Misperception of risk can have a significant impact on the success of any information provision program. Empirical evidence indicates that consumers will ignore information which they feel has little benefit. Consequently, if consumers perceive little risk (cost) associated with using a product, they are unlikely to seek out and process information about a product’s potential risk. For example, unlike the provision of unit pricing information, the provision of nutritional information associated with proteins, minerals, and vitamins has little impact on consumer behavior [Muller 1985, Russo, Staelin, Nolan, Russell, and Metcalf, 1985]. Thus, although almost 50 percent of the consumers became aware of the availability of this nutritional information which was presented in formats found in previous applications to facilitate use, only a few consumers took the time and effort to read through the available information. Even fewer seemed to use the information to alter their purchase behavior. On the other hand, when nutritional information concerned negative attributes such as the amount of sodium, sugar, and calories, it appeared to have significant impact [Russo et al. 1985]. The difference in results of these two types of nutritional studies may be due, at least in part, to the fact that the former study provided information about nutrients for which the consumers perceive little risk (i.e., from malnutrition), while the latter studies provided information on attributes for which consumers perceive a much higher risk (e.g., salt and sugar). This perception of risk, in turn, resulted in consumers seeking out and using the newly provided information.

Finally, what happens when people are asked to integrate multiple items of risk information into an overall judgement of risk? A product like drain openers, for example, includes risks of contact burns and poisoning. Do
consumers, when faced with such products, integrate the multiple risks associated with a product into a reasonable overall judgement of risk? Are those overall judgements then used in selecting among products? An alternative approach consumers might use is to compare products directly on a risk-by-risk basis.

Although there is relatively little research on the questions above, a recent study by Svenson [1985] does provide some initial answers to the questions. He asked subjects to judge the cumulative risk of dying during a year for a set of persons, each characterized by different levels of risk for three different periods during the year. For example, a person might be characterized by risk exposures of (1) 18 weeks at 2.3 deaths per thousand persons per year of exposure, (2) 28 weeks with 2.5 deaths per thousand per year, and (3) 6 weeks with 16.0 deaths per thousand per year. He found that some subjects used simple strategies that completely ignored the importance of different exposure times, e.g., they computed the mean of the risk levels. Other subjects did try to incorporate all the relevant information through an anchoring and adjustment process. However, even for these subjects, there was a tendency not to properly weight exposure times. Consequently, subjects tended to overestimate cumulative risks that included a period of short exposure to a high risk.

The Svenson study does not directly address the problem of integrating multiple product risks into a judgement. It also does not deal with the problem of choice among products with different risk profiles. Nonetheless, the Svenson study is consistent with the general result from decision research that people find it difficult to combine multiple items of information and therefore may be biased in forming perceptions of the overall risk associated with a product that has multiple risks.

Making Risky Choices

Psychological research also indicates that people have great difficulty in making decisions among risky options where the person could experience either a gain or a loss [Payne 1985]. This difficulty is of concern, since one of the tenets underlying information provision is that consumers can easily make such a "rational" decision. However, empirical evidence indicates that people would find it difficult to trade off the greater perceived benefits of one brand of household cleaner against those of a second brand of cleaner when the former brand also has associated with it a greater perceived risk. This difficulty in trading off risks against benefits is increased to the extent that information about comparative risks and benefits is not readily available to the consumer and/or is not in a form he or she can easily use.

Given this difficulty, how do people normally deal with making everyday risky choices? One approach is simply to deny the risk. Slovic, Fischhoff, and Lichtenstein [1980] suggest that whenever possible, people will try to avoid the gambles inherent in life's dangerous activities by viewing the risk of an activity as either so small that it can be safely ignored or so large that it clearly should be completely avoided. This implies that one problem in designing the labels of the household chemicals may be to describe the risks as large enough to be reckoned with when choosing among products without making them so large that people refuse to use the product at all.

Another way people reduce the difficulty of making decisions under risk is to adopt heuristics or rules of thumb for trading off positively and negatively evaluated attributes. Heuristic choice rules are simple procedures for making choices that normally do not use all the available information. The use of heuristics in making choices increases as the decision problem becomes more complex [Payne 1976].
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A similar problem occurs when the amount of information provided is large. Such a situation is often referred to as information overload. Although the empirical evidence is equivocal, there is some indication that making available large amounts of information can actually cause consumers to make poorer decisions [Malhotra 1982, Keller and Staelin 1985]. For example, a consumer might decide to focus solely on one item of information in comparing brands, e.g., price, if the number of brands or amount of information about the brands is seen as being too much. Alternatively, a consumer might examine one brand at a time and see if that brand has “acceptable” values on some subset of the brand’s attributes. If so, the consumer may not make any comparisons to other alternatives. Hence, an important issue in the design of product labels is to present sufficient information for informed choices without presenting so much information that consumers will process it selectively, possibly leading to suboptimal choices.

Task Effects of Decisions

An important principle governing the use of heuristics in dealing with complex decision situations is that individuals are adaptive. That is, it has been found in many studies that the strategies used are contingent upon the particular characteristics of the situation [Payne 1982]. Such effects are often called task effects, and properties of choice situations such as the number of alternatives, the format in which the information about alternatives is presented, or time pressure affect the heuristics used by decision makers. This adaptivity to the situation is probably the most consistent finding in the research on decision making.

The format in which information is presented is one task effect of particular interest. In Russo’s [1977] study of unit pricing at supermarkets, mentioned earlier, the major comparison was not to the case where no unit price information was available, but rather to the situation where the same information was displayed differently through separate shelf tags. The improved format aided decision-making by making the same information easier to process. The study did not add either new alternatives or new information to the task environment of the supermarket shopper.

The importance of format is also borne out in a study of automobile safety by Slovic, Fischhoff, and Lichtenstein [1978]. This study is of special relevance because it concerns provision of risk information. The basic idea was that people may not wear seat belts, in part, because the (correct) perception that the probability of a fatal accident on a single automobile trip is extremely small. A fatal accident occurs only about once in every 3.5 million person trips and a disabling injury only once in every 100,000 person trips. Presenting risk information on a single trip basis makes the reluctance to buckle up seem reasonable. Slovic, Fischhoff, and Lichtenstein reasoned that the probability of harm would have to be seen as exceeding some minimum value before people would respond to the risk. Consequently, they reformatted the information about automobile accident risks from a single trip perspective to a multiple-trip perspective. Considering a lifetime of driving, the probability of being killed rises to .01 and the probability of experiencing at least one disabling injury is .33. In an exploratory study, they found that expressed attitudes with respect to seat belts (and airbags) were more favorable with the accident information presented in the lifetime format as opposed to the single trip format. A similar attempt to reformat energy costs was undertaken in Hutton and Wilkie [1980]. They found that presenting cumulative energy costs for the entire life cycle of a refrigerator could lead to choices which saved as much
as 15 percent in energy costs compared to presenting average per year energy costs. See Bettman [1979], Fischhoff, Slovic, and Lichtenstein [1980], Magat, Payne, and Bruccato [1984], and Tversky and Kahneman [1981] for other examples of effects of different information decision behavior.

The Human as an Information Processor

Thus far we have discussed a number of factors, such as perception of risk and format of information, which can alter a person's decision. We next discuss why these factors are influential. We do this by presenting some basic properties of the human mind as a processor of information. Over the past 30 years, psychologists have greatly expanded our knowledge of the human information processing system. The next part of this article will provide a brief overview of this system. Obviously, a brief summary of the vast literature on human information processing must involve simplifications. Nonetheless, we believe that an awareness of the basic components of the human information processor is necessary for the design of effective labels.

One of the most important theoretical postulates in current psychology is that people operate as information processing systems. Research has tried to describe behavior, e.g., a consumer choosing a product, in terms of a small number of memories and processes (strategies) involving the acquisition, storage, retrieval, and utilization of information [for reviews, see Haugeland 1981, Newell and Simon 1982, Bettman 1979].

The set of memories and processes that interact with the environment to produce behavior can be divided into three major subsystems: (1) the perceptual system; (2) the motor system; and (3) the cognitive system [Card, Moran, and Newell 1983]. The perceptual system consists of sensors (receptors), such as the eyes and ears and associated buffer memories. It translates sensations from the physical world (i.e., visual or aural input) into symbolic code that can be processed more fully by the cognitive system. The motor system, on the other hand, translates thought into action by activating patterns of voluntary muscles. Much research has been done to understand the components of these two subsystems. Some of that work is relevant to the design of labels. For example, the amount of information a reader can take in with a single eye-fixation has been shown to be a joint function of the perceptual difficulty of the material (e.g., spacing of letters) and the skill of the reader. Furthermore, it has been estimated that the upper limit on the rate of reading, without ignoring some words in a text, is approximately 600 words/min. Such restrictions can become important in some instances (e.g., when determining how much information to put in a television message). However, for the purposes of the design of effective labels, the most important subsystem to understand is the cognitive system.

The Structure of Human Memory

In discussing the cognitive system, most researchers have found it useful to distinguish between two types of memories: (1) Working Memory, and (2) Long-Term Memory. Working Memory contains the information under current consideration. Long-Term Memory (LTM) holds (stores) the individual's mass of available knowledge, including both facts and procedures for doing things. We will briefly review what is known about both memories. It should be noted that this distinction does not necessarily imply that there are two physically distinct memories. Working Memory may simply be the currently activated portion of Long-Term Memory. It is the different functioning of these two types of memories which is the crucial distinction.
Working Memory

Working Memory can combine information from both the environment, as produced by the perceptual system, and information drawn from (retrieved) Long-Term Memory. For example, in solving an arithmetic problem, one uses both the given information (numbers) and the procedural information—the rules of addition stored in Long-Term Memory. Working Memory also contains the intermediate products of thinking. The other name that is often used to refer to Working Memory is Short-Term Memory. That name captures the important fact that items of information in Working Memory can be lost in 20 to 30 seconds if not actively rehearsed.

The most important fact to know about Working Memory is that it is limited in capacity. That is, only a few items of information can be considered at any one time. How few? The standard answer to this question is seven items of information, plus or minus two [Miller 1956], although some researchers have recently suggested that roughly four to five items is a more accurate estimate [Simon 1974]. This capacity limitation is easily shown using a memory span task. The task requires that a person recall a sequence of items in their correct order. For example, a person might be read the following sequence of twelve letters and then asked to recall it in the correct order:


Most of us would find that a very difficult task. We could, however, probably do the following task: M—C—A—S. Seven to nine letters is the limit for most of us. The number of items of information recalled, however, can be increased by recoding the information to form “chunks.” What constitutes a chunk of information is somewhat ill-defined, but it might be best characterized as any piece of information that is represented as a single, meaningful item or that has some unitary representation in long-term memory. To illustrate, consider a re-ordering of the 12 letter sequence given above:

T—W—A—I—B—M—C—I—A—C—B—S.

For most people in this culture, the twelve letters now can be formed into four chunks—TWA, IBM, CIA, CBS—that are easy to recall. This increase in recall due to chunking can be dramatic. In one instance, a student was trained to recall 81 digits [Chase and Ericsson 1981]. The student, an avid runner, was able to chunk the numbers into a much smaller set of items by relating the sequence of numbers to running times.

Another example of the limitations of Working Memory is provided by the task of trying to multiply two four-digit numbers. Even if the numbers are easily remembered, e.g., 1776 and 1492, the need to process intermediate products will tax the capacity of most people’s Working Memory.

The Working Memory capacity limitations have several important implications for decision behavior in general and responses to information labels in particular. For example, instances of information overload can be traced to limitations in Working Memory. There are limits to how much information it is reasonable to expect a consumer will be able to process from a label in any reasonable amount of time. Given the cognitive efforts and limitations involved, Bettman and Kakkar [1977] have shown that people often do not transform the information, but instead process it in the form given. This is one of the reasons why the same information given in different formats (e.g., risk per trip versus risk per lifetime) can have a different impact on a person’s decision.

A second consequence of a limited Working Memory is the use of heuristics to process information [Haugeland 1981, Card, Moran, and Newell 1983]. Heuristics are procedures for systematically simplifying the
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search through the available information about a problem. That is, heuristics function by disregarding some of the available information. Heuristics improve a person's chances of making a reasonably good decision given the limitations in processing capacity, while leaving some possibility of a "mistake." The use of heuristic strategies to solve problems and make decisions is one of the general principles of human information processing. Newell and Simon [1981] have argued that the use of heuristic search is at the heart of intelligence.

Thus, a major goal in the design of information systems is to take advantage of the power of heuristics while minimizing their potential for errors. This means that effective labels should be designed with the awareness that most people will adopt simplifying strategies for processing the information on the label. By designing labels so that effective strategies are simpler to implement, the use of such strategies can be encouraged. The basic concept is that mental processing capacity should be viewed as a scarce resource. To the extent that the mental effort associated with that processing can be reduced, people will tend to process more of the available information.

Long-Term Memory

Unlike Working Memory, Long-Term Memory's capacity is generally thought of as infinite. That is, for all practical purposes there are no limits to the amount of information that can be stored in Long-Term Memory. It has also been suggested that once information has been transferred from Working Memory into Long-Term Memory it is never lost. Obviously, however, we do "forget" information. What is suggested is that forgetting really is just the person's inability to retrieve the information from Long-Term Memory at a particular point in time. At different periods, new retrieval cues or strategies may allow the person to remember information that was previously viewed as forgotten.

Because of its capacity, Long-Term Memory is sometimes viewed as an external memory, just like a library, encyclopedia, or management information system [see Simon 1981 for an elaboration of this view]. Problem solving and decision making would then involve search for information in both the external perceptual environment and the memory environment, with information from one environment often guiding the search in the other.

In spite of its unlimited capacity, not all information that is perceived, i.e., placed in Working Memory, is transferred to or stored in Long-Term Memory. In part this is due to the amount of time it takes to transfer an item of information to Long-Term Memory. Writing (storage of) an item of information into Long-Term Memory takes about seven seconds of processing effort. In contrast, it has been estimated that retrieval from Long-Term Memory is orders of magnitude faster than writing to Long-Term Memory [Card et al, 1983]. As noted by Card, Moran, and Newell [1983, p. 4], "this asymmetry puts great importance on the limited capacity of Working Memory, since it is not possible in tasks of short duration to transfer very much knowledge to Long-Term Memory as a working convenience." This fact has implications for the sequence of operations that are likely to make up a decision strategy [Johnson and Payne 1985]. It is also related to why the organization of information for the unit pricing study discussed above was so successful. It reduced the need to transfer information to Long-Term Memory in making unit price comparisons among brands since all of the information was located externally on one list and the brands were listed in order of increasing unit price.
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Capacity and read and write times are just some of the features of Long-Term Memory. A number of other memory issues have been addressed in the literature. Two general issues of great importance to effective label design concern the way information is stored and recalled.

The storage of information in Long-Term Memory involves encoding operations. The most commonly discussed result of encoding is in terms of representing information in the form of semantic associations. That is, information is processed and encoded in the form of separate concepts and the associations among those concepts. An example of this form of representation for bleach with some encoded risk information is provided in Figure 3. Note that in this example the concept of risk is encoded with the generic concept bleach instead of being associated with the two specific brands, Bright Bleach and Clorox. If this were the case, then the consumer would not perceive different risk levels for the two brands. Consequently, the riskiness of the product should not influence the consumer’s decision between the two brands, for this specific example. If a policy maker wanted this consumer to choose among brands on the basis of risk, the coding of the information must be changed so that specific risk levels are associated with each brand.

Given the importance of the way consumers encode information on how they ultimately use this stored information in making a decision, it is necessary to understand better the factors which affect the encoding process. One important feature is that the acquisition of new knowledge, e.g., from a label, appears to be greatly facilitated by the existence of previously acquired relevant knowledge that can be used to form associations. This suggests, for example, that use of both a common format and a common set of concepts in labeling hazardous chemicals across products would facilitate a consumer’s ability to successfully encode hazard information about a new brand once the format had been learned through prior experience with other labels. Put differently, the learned structure will enhance future encoding of new information which fits into that existing memory structure.

Knowledge must not only be encoded in Long-Term Memory, but also, given the vast amount of information an individual acquires, it must be organized. Otherwise, it would be impossible to retrieve a needed piece of information from Long-Term Memory. Many psychologists think Long-Term Memory is organized in hierarchical clusters of related knowledge. Figure 3 shows one such hierarchical form, while Figure 4 represents a more expanded hierarchy for bleach, although it too is very simple. Obviously, hierarchies can be much more complex. Furthermore, hierarchies are often embedded in other hierarchies. The bleach hierarchy, for example, could be part of a much larger hierarchy dealing with cleaning agents.

The value of hierarchies in the recall of information is clear. Studies have shown that information learned in an organized, hierarchical fashion can be recalled much more effectively [Reed 1982]. To illustrate, consider the memory span test discussed earlier. The ability to chunk letters into meaningful patterns, e.g., IBM or CBS, improved performance. However, trying to recall more than four or five such chunks is difficult for many people. Now consider the following sequence of letters:

I—B—M—D—E—C—D—C—B—S—A—B—C—N—B—C

Possible chunks are IBM, DEC, CDC, CBS, ABC, NBC. The first three chunks represent one branch of a hierarchy devoted to computer companies and the second group of three chunks is part of a branch devoted to television networks. The overall hierarchy might represent companies in
Notice that in this example the attribute Hazardous is associated with the concept of bleach, not with individual brand names.

the information/communications business. Without such a hierarchy, recall of the information would be much more difficult. As shown in a subsequent section, one of our recommendations for effective label design builds on the implications of hierarchical structure research.

Policy Implications of Consumer Processing Limitations

The brief summary above has indicated that consumers have limited capacity to process information and that coping with information about risks is complex and difficult. These conclusions are contrary to the typical assumptions that consumers are extensive information processors and that
providing more information is always helpful. Rather, consumers may use simplifying heuristics to limit processing. Thus, merely making information available may not be sufficient. Instead one must distinguish between the availability and the processability of information [Russo, Kriese, and Miyashita 1975]. Processability refers to the ease with which information can be comprehended and used. In general, information must be both available and easily processable to be utilized.

Processability of information is a function of the way the information is presented. That is, presenting information that is well-organized and in formats that facilitate processing can increase usage of that information. For example, providing information about potential poisoning hazards on a common rating scale for products containing toxic chemicals would facilitate comparisons across those products about such risks.

Processability is not only a function of how information is provided. The kind of processing to be done is also important. As noted above, consumers may use different processing strategies depending upon the task. Alternatively, policy makers may wish to encourage certain types of processing. For example, when the consumer is purchasing the product, the policy maker may wish to encourage comparisons of various brands with respect to their degree of potential hazard. On the other hand, when the consumer attempts to use the product, he or she would like to have simple instructions for using the product to avoid risks. The major point in these examples is that different types of processing are facilitated by different types of formats and organizations of the information. No one format is optimal for all types of information and/or situations. Rather, processability depends upon the congruence between the format and organization of the information and the type of processing to be done [Bettman 1979]. Our approach, therefore, is to consider the format and organization of product labels relative to consumer processing tasks.

The discussion above implies that particular formats and methods for organizing information can greatly influence the ease with which various types of processing can be carried out. Thus, the congruence between format and type of processing is crucial. It should be noted that there are two basic approaches to congruence. The first is reactive. That is, one can attempt to determine how consumers are currently processing information and thus one can use formats to make that type of processing easier. A second approach, particularly relevant for policy, is more proactive. The policy maker determines types of processing he or she wishes to encourage (e.g., making more comparisons across brands) and designs formats which facilitate such processing. As we noted before, there is some evidence that consumers tend to process information in the format in which it is provided rather than transforming it [Bettman and Kakker 1977]. Therefore, the policy maker may be able to facilitate certain types of processing through judicious design of information provision.

In the following, therefore, we will examine general principles of format and organization as they relate to processing tasks. There are three major considerations:

1) Reducing the cognitive effort and/or time needed to locate the externally available information, retrieve any previously stored information, and encode the newly provided information.

2) Reducing the cognitive effort and/or time needed to make risk-benefit tradeoffs within a particular brand or alternative being considered.

3) Reducing the cognitive effort and/or time needed to make comparisons across different brands or alternatives.
Designing Effective Labels

Each of these aspects is discussed in turn.

One important factor in designing labels is that it should be easy for the consumer to locate particular pieces of information when needed and to encode their meaning once located. For example, information on how to avoid certain risks and on the appropriate antidotes should be easy to find on the label. The consumer should not have to search through fine print or hunt all over the label. When found, the information should be easily understandable.

There are several design principles which can be used to facilitate ease of location and encoding. To facilitate finding information, one can make it more salient by using different colors or sizes of type (e.g., large letters in a color which contrasts with the other printing on the label). While this will be partially effective, organization of the label may be even more crucial. It would help enormously if information on various factors were put in the same relative position on all labels. That is, if the consumer knew that antidote information was always at the bottom of the label or that instructions for avoiding risk during usage were on the middle-right of the label, locating the desired information would be greatly facilitated. In addition, as noted in the above discussion of memory, processing will be facilitated if such a common format is arranged in a way that is consistent with how people like to process and encode the information. Since hierarchical organizations seem very effective, information may be more readily processed if it is presented hierarchically in the order consumers are likely to use it. For example, Kanouse and Hayes-Roth [1980] developed the following hierarchy for prescription drugs: What is the product, what are its benefits and risks, how should it be used, what risks in use are there and how can these risks be avoided, and what should be done if the product is not used properly?

To facilitate the encoding of information once it is located, the information should be simple and easily understood. One device which may be very useful here is the use of symbols wherever possible. An example of this idea would be to use symbols to represent the degree of various potential hazards. Figure 5 shows hazard symbols used in Canada. By using symbols which immediately connote specific types of hazards, this system can depict both the type and degree of hazard in a quickly and readily understood fashion. Thus, to facilitate ease of location and encoding information, one should:

a) Make important information more salient via color and/or type size.

b) Use a common organization for information on all labels.

c) Design this common organization hierarchically and in a manner compatible with the scheme used by most consumers to store information about the product.

d) Use symbols which quickly convey the concept when possible.

The policy-maker may also like to encourage consumers to make risk-benefit tradeoffs within a given alternative by getting the consumer to explicitly compare the risks and benefits for a specific product before deciding whether or not to purchase it. This process will be facilitated to the extent that information on the benefits of the product is presented in one place while information on risks is presented in another, preferably close by. Thus, to facilitate ease of making tradeoffs within a particular alternative, one should:

e) Collect information on benefits in one place on the label.
<table>
<thead>
<tr>
<th>NATURE</th>
<th>POISON</th>
<th>FLAMMABLE</th>
<th>EXPLOSIVE</th>
<th>CORROSIVE</th>
</tr>
</thead>
<tbody>
<tr>
<td>DEGREE</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DANGER</td>
<td><img src="#" alt="Image" /></td>
<td><img src="#" alt="Image" /></td>
<td><img src="#" alt="Image" /></td>
<td><img src="#" alt="Image" /></td>
</tr>
<tr>
<td>WARNING</td>
<td><img src="#" alt="Image" /></td>
<td><img src="#" alt="Image" /></td>
<td><img src="#" alt="Image" /></td>
<td><img src="#" alt="Image" /></td>
</tr>
<tr>
<td>CAUTION</td>
<td><img src="#" alt="Image" /></td>
<td><img src="#" alt="Image" /></td>
<td><img src="#" alt="Image" /></td>
<td><img src="#" alt="Image" /></td>
</tr>
</tbody>
</table>

Source: Canadian Hazardous Products Act 1970

f) Collect information on risks in one place on the label.
g) Organize the label so that the information on benefits and risks are in close proximity.

Finally, a label should facilitate making comparisons across several alternatives. For example, the consumer may wish to find the product for a particular use with the least hazard from poisoning. Providing information on a common hazard scale and with the same overall organization on each label will help. However, this format still requires that the consumer examine several different packages. Thus, it would be desirable to find a way to communicate comparative information. One way to do this would be to provide on each product's label the range of potential hazards over all products in the category. For an example of this notion, see Figure 6. A similar approach is used on many household appliances and automobiles, where the minimum and maximum energy consumption of any brand.
within the product class is given as well as the particular brand’s energy consumption.

Unfortunately, even such comparative scales are not always sufficient for making comparisons easier. Thus, knowing that there are products with lower hazard levels does not help the consumer find them. For this reason, product labels alone may not be sufficient for making comparisons across products easy. As in the unit pricing experiments, a list of products ordered by potential hazards affixed to the shelf at the point of purchase could facilitate the consumers’ comparisons of hazards across brands. Thus, to facilitate comparisons across brands, one should

h) Provide information in a relative or comparative format.

i) Consider in-store comparative lists in addition to labels.

The general principles considered above provide broad guidelines for label design. Before presenting our specific application of these ideas to the design of labels for products containing hazardous chemicals, however, it is useful to briefly consider how different processing tasks and different modes of presenting information interact with these principles.

The major situations faced by consumers regarding products containing hazardous chemicals are purchase and use. In the purchase situation, facilitation of risk-benefit tradeoffs for a specific brand as well as comparisons across brands are particularly important. The consumer may make a buy/not buy decision for a whole category of products based upon tradeoffs of benefits and risks. If a decision is made to purchase the category, comparisons among brands may be crucial. For the usage situation, on the other hand, the ease of finding information on proper usage and information on antidotes in case of an accident are more relevant. The point is that different types of information are more important in different situations, and the policy maker should take this into account in deciding how information is to be provided.

Different modes for providing information also have different properties. For example, using television or radio messages implies that limited time is available for processing, since the viewer or listener cannot control the speed of presentation. Hence, due to the limitations of the Working Memory, previously discussed, complex information should probably not be
Bettman, Payne, and Staelin

presented. Broad notions of benefits and the potential for hazard are probably all that can be readily communicated. Print advertisements can provide more information, since the reader can control the speed at which information is received. However print ads, like TV and radio messages, are generally not available at the point of purchase. Hence, if the information is to have an impact, consumers must recall the potentially complex information from Long-Term Memory, a task which is often difficult.

Labels, however, are available at the point of purchase, and judicious design can facilitate risk-benefit tradeoffs and can provide clear use instructions. As noted above, facilitating comparisons across brands may require an in-store list. Package inserts can provide more detailed information than any of the above. However, reliance on such inserts cannot be primary, since they are usually not easy to access at time of purchase and may be discarded and not be available during use, particularly when the product is used over multiple occasions.

In sum, different types of processing are desired in different situations, and different modes of information provision have different characteristics. In particular, no one method is effective for all types of processing. Rather, an information provision system is necessary, using several methods which complement each other [Wilkie 1975, Wright 1979]. Such a system is described below for products containing hazardous chemicals. While the label plays a very central role in such a system, it is not the only component.

A Labeling System for Products Containing Toxic Chemicals

As discussed above, a labeling system is to provide information to consumers in many ways (e.g., ads, in-store displays, package labels, package inserts, general consumer education programs). Each of these ways is best suited to provide certain types of information, but may be ill-suited for others. For example, in-store displays may be very effective at helping consumers compare different products that could accomplish the same purpose. However, such displays would not be as effective for communicating safe usage instructions at the time of use. Hence, a labeling system has a number of advantages. First, it can provide information in a number of different formats, each format being tailored to the particular situation. Second, since not all the information has to be in one place, the information provided in one part of the system can complement that provided in other parts of the system.

Our labeling system has four major components: advertisements, point of purchase (POP) displays, labels, and package inserts (PI). Each part of the system plays a different role in providing information to consumers. We have concentrated our efforts on the labeling portion of the system. However, the other portions are also of great value.

In designing this labeling system, we decided not to include general consumer education programs. The usual objective of such education programs is to provide general knowledge about a product class or product classes versus specific knowledge about one or more brands within a product class. However, there is little evidence that such programs are cost effective in terms of modifying consumer behavior [Staelin 1978, Adler and Pittle 1984]. Consequently, although education programs designed to provide consumers with generalized knowledge of strategies (heuristics) on how to better evaluate the risk aspects of a product class or the risk inherent in using that product class would be helpful, we believe our proposed labeling system need not rely on the existence of such programs.

There are several goals we would like to accomplish with our proposed
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labeling system. These include: (1) motivating the consumer to examine information about the toxic chemicals, both at time of purchase and at time of product usage; (2) making it easy for the consumer to realize the level of hazard potentially posed by a particular product, both at time of purchase and at time of use; (3) making it easy for the consumer to compare at the point of purchase the levels of hazard posed by several products which could be used to satisfy the same application; (4) making it easy for the consumer to see how to use the product safely; and (5) enabling the user to take the correct course of action if the product is misused. Thus, we want to make it more likely that consumers will have available and will use the appropriate information both for deciding whether or not even to purchase the product (level of hazard and comparison of such levels) and for learning how to use the product safely once it has been purchased. The various components of the labeling system vary in how well they can achieve these goals, as noted below.

Advertisements

Ads are viewed by consumers at a time different from either purchase or use. Thus if the consumer is to use the information at these times he/she must encode the message when viewing the ad and then retrieve the acquired information at a later time. Consequently, this medium is not in general as effective in providing hazard information as point of purchase displays, labels, or package inserts which are available at purchase or use. Moreover, given the time limitations associated with a TV ad (TV ad exposures are normally 30 seconds or less), we do not believe ads can effectively convey detailed safety information.

This does not mean that ads cannot be used to enhance a labeling system. Ads can be effective in conveying general moods and settings. Also, there is some research which indicates potential benefits from showing consumers looking at and using labeling information in advertisements (ads) [Wright 1979]. Thus, instead of requiring the manufacturer to provide specific label information in an ad, it may be better to require manufacturers to show consumers consulting labeling information, with a brief verbal statement that such products can be hazardous and one should always consult the label.

The purpose of providing the correct “model” behavior and a brief warning in the ad is to motivate consumers to do the same in the store. Analogously, modeling proper usage of the product in advertisements, e.g., having the ad show people wearing rubber gloves when using the product, may be of value. In other words, the main goal of ads with respect to hazard information should be to motivate the consumer to consult other components of the labeling system rather than to deliver detailed hazard information. In this way ads can be thought of as educational, in that they provide general strategies and knowledge about a product or product class rather than detailed product information.

Point of Purchase (POP) Displays

POP displays have always been shown to have a strong influence on purchase behavior in situations where comparative product information has value. Thus they are appropriate when it is desirable to shift usage patterns so that the least hazardous product types are used for any given application. Determining these least hazardous product types requires comparisons across products. Such comparisons may not be easy to make, even if labels are well-designed. Moreover, if such comparisons are difficult, there is much less likelihood they will be made.

Perhaps the best examples of the impact of comparative product
information are the aforementioned studies on the use of unit price and nutritional information. An analogous POP display would be a list of products ranked by degree of potential hazard. Such lists would be most valuable whenever there are multiple products (with varying degrees of hazard) which can be used for the same application, since the list would make comparisons much easier.

To implement the point of purchase component, retailers would post lists that provide hazard levels for specific hazards for all brands that claim they can be used for a specific application (we specify the hazards to be considered in the labeling section below). For example, Table 1 shows a list for products designed to unplug drains. The list might show dry chemicals (e.g. Drano) and liquid chemicals (e.g. Liquid Plumber). Since these two types of products pose different types and levels of risk to the user, comparative information would allow the consumer to more easily make a comparison of these two types of products and trade off the risks and benefits. Such a display greatly enhances the ability to make comparisons across several types of products, and also makes the consumer aware of all the alternatives for a particular application. Without such a list, the consumer would have to look at individual brand labels and make his or her own comparisons, a much harder task, which most consumers might not attempt or might not be able to do.

Our proposed POP list displays all of the hazard component information, while another approach would simply present an overall summary measure of risk. Such a summary measure would reduce the task of integrating risk information. However, work by Russo and Staelin et al. [1985] in the area of nutritional POP displays suggests that summary ratings by themselves were less used than lists which contained all the nutritional information. Perhaps more interestingly, summary ratings combined with more decomposed ratings were less used than the decomposed ratings. In the Russo et al. study, this may have been because consumers did not understand or accept the basis for the summary rating. Much more research is needed to identify when summary ratings will be effective additions to decomposed listings of risks.

There are several practical issues involved in implementing this component of the system, of course. First, one must be able to specify all the products that can be used for a specific purpose, which may be difficult. Second, it would be necessary to collect the information on risk levels for each product on all hazard dimensions. This latter task should not be too onerous, assuming that our proposed labeling system is implemented, since the quantification of risk levels would appear on each product's package label. Third, the lists must be prepared and maintained either by the retailer

<table>
<thead>
<tr>
<th>Brand</th>
<th>Swallowing</th>
<th>Contact</th>
<th>Breathing</th>
<th>Flammability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drano</td>
<td>XX</td>
<td>X</td>
<td>XX</td>
<td></td>
</tr>
<tr>
<td>Liquid Plumber</td>
<td>XXXX</td>
<td>XX</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brand C</td>
<td>XX</td>
<td>XX</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brand D</td>
<td>XX</td>
<td>XX</td>
<td>XX</td>
<td></td>
</tr>
<tr>
<td>etc.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*The more symbols the greater the risks.*
Designing Effective Labels

or by the government. Any law that requires the retailer to provide a list of products available in that outlet could place a cost burden on retailers, particularly smaller retailers. Such costs would presumably then be passed on, at least in part, to consumers. If the government prepares such lists, these lists would need to include all products, whether stocked in that store or not, and such lists might be difficult and costly to prepare. While these cost issues are certainly significant, past empirical evidence indicates that potential benefits also can be substantial in situations where the information presented is valued by the consumer. Hence, this cost-benefit tradeoff should be seriously considered.

Labeling

The label provides information both at time of purchase and at time of use. Thus, it is relevant to two of our goals: communicating level of hazard, and telling one how to use the product safely. In this way it can affect whether or not a product is even purchased, and how it is used. Since it has dual goals, we have attempted to develop a format for the label that maximizes its usefulness in both situations. In addition, labels can be used to cue the use of other sources of information. Ley [1980] has argued that warning labels are unlikely to ever be adequate as the sole source of information on health risks. He suggests that people want to know more details on why a product is harmful and what to do than can be provided by a label. Consequently, he proposes that the warning label act as a cue for recall of more detailed information provided by such things as package inserts. This idea of referencing other sources fits into our concept of a total information system.

In the following section, we discuss the needed components for any label. Our goal was to develop a single label design which would suffice for both experienced and inexperienced consumers. We did this by applying the general principles outlined earlier in this chapter. Examples of two labels designed from these principles are shown in Figures 7 and 8.

All labels should have seven components: (1) a statement of what the product is (name and ingredients), (2) a statement of the product’s benefits (i.e. uses), (3) a symbolic visual display of risk levels for specified types of hazards, (4) a statement of the types of bad outcomes (dangers) that can occur, (5) the actions that should be taken to avoid such dangers, (6) a statement of how the product should be used to derive the stated benefits, and (7) the antidotes (actions) that should be taken if a bad outcome occurs. These components allow the consumer to trade off risks and benefits and provide information relevant to safe usage.

We specified a standard format for delivering this information because we believe this will facilitate the consumer’s ability to use and encode it. Thus, if a particular type of information is in the same place on all labels, consumers will quickly learn how to locate that information rapidly [Hadden 1983].

In addition to having a common format, the label’s organization should be designed to facilitate processing. As argued above, the label should be designed hierarchically, so that the information consumers desire is listed in the order they might use it. Thus, the general order and organization used is as follows:

Name of the Product

Benefits of the Product

Potential Hazards

Dangers (Bad outcomes)

How to Avoid Dangers

How to Use to Derive Benefits

Antidotes
**Test Label for Vector Cleaning Agent**

**Vector Cleaning Agent**

**Product Uses**

- **VECTOR Cleaning Agent**
  - Cleans bathrooms and kitchens
  - Removes stubborn stains in baths, kitchens, and on countertops
  - Whitens and removes stains in laundry

**Potential Hazards**

- **Swallowing**
- **Contact**
- **Breathing**
- **Flammability** (NONE)

**DANGERS**

- **HARMFUL IF SWALLOWED**
- **CAUSES SEVERE EYE IRRITATION ON CONTACT**
- **CAUSES SKIN IRRITATION ON CONTACT**
- **WILL RELEASE HAZARDOUS GASES IF MIXED**
- **WILL DAMAGE METAL**
- **WILL DAMAGE SOME FABRICS**

**HOW TO AVOID DANGERS**

- **KEEP OUT OF REACH OF CHILDREN**
  - Avoid contamination of food
  - Store on high shelf
  - Store in locked cabinet
  - Do not store in any other container

- **Avoid splattering while using**
  - Do not transfer to any other container

- **Avoid splattering while using**
  - Do not transfer to any other container

- **Do not use in combination with ammonia or products containing acids, such as toilet bowl cleaners, rust removers, vinegar**
  - Do not use this bottle for storage of any other liquid

- **Avoid prolonged contact with metals**

- **Do not use on silk, wool, nonfast colors, acetate, spandex, leather, or 100% cotton treated with flame-retardants**

**DIRECTIONS FOR USE**

How much Vector should you use?

To get the best laundering results use the proper amount of cleaning agent. See below for usage amounts.

* Large top-loading automatics - 1½ cups
* Front-loading automatic - ½ cup
* Regular top-loading automatics - 1 cup
* Heavy soil-increase amount by ¼ cup

What fabrics can you launder?

Cotton, linens, synthetics, permanent press, nylon, Dacron, Orlon, and rayon can be safely cleaned. You can test any article to determine if it is laundry-safe by applying one drop of Vector (1 teaspoon mixed with 1/4 cup water) to a hidden part of the fabric. Be sure to check all colors. If colors do not change, Vector can be safely used on the article.

What stains can be removed?

- Fruit berry, wine, coffee, tea, grass, dye, and medicine stains can be removed.

**EMERGENCY TREATMENT:**

- **IF SWALLOWED:** Induce vomiting. Feed milk for several days.
- **IN EYES:** Flood with water. Call physician.
- **ON SKIN:** Flood area with water. Call physician if irritation persists.
Designing Effective Labels

Test Label for Unstop Drain Opener

Unstop Liquid Drain Opener
Read Entire Label Before Opening or Use

<table>
<thead>
<tr>
<th>Product Uses</th>
<th>Potential Hazards</th>
</tr>
</thead>
<tbody>
<tr>
<td>UNSTOP Liquid Drain Opener</td>
<td>Swallowing</td>
</tr>
<tr>
<td>Opens clogged drains</td>
<td>Contact</td>
</tr>
<tr>
<td>Keeps drains open</td>
<td>Breathing</td>
</tr>
<tr>
<td>Will not harm pipes</td>
<td>Flammability</td>
</tr>
<tr>
<td>or septic tanks</td>
<td>NONE</td>
</tr>
</tbody>
</table>

**DANGERS**

<table>
<thead>
<tr>
<th>Harmful or Fatal If Swallowed</th>
<th>HOW TO AVOID DANGERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAUSES SEVERE EYE DAMAGE ON CONTACT</td>
<td>KEEP OUT OF REACH OF CHILDREN</td>
</tr>
<tr>
<td>CAN SPATTER IF MISUSED</td>
<td>Store on high shelf</td>
</tr>
<tr>
<td>WILL HARM SOME MATERIALS</td>
<td>Store in locked cabinet</td>
</tr>
<tr>
<td>WILL HARM SOME MATERIALS</td>
<td>Always keep safety cap on bottle</td>
</tr>
</tbody>
</table>

**EMERGENCY TREATMENT**

**IF SWALLOWED:** Do NOT induce vomiting. Give large quantities of water or milk. Seek medical care immediately.

**IN EYES:** Immediately flush with water for at least 15 minutes. Seek medical care immediately.

**ON SKIN:** Flood area with water for at least 15 minutes. If irritation persists, seek medical care.

**DIRECTIONS FOR USE**

TO OPEN: Place bottle on flat, steady surface. Press down on cap while turning in a counter-clockwise direction. Do not squeeze bottle.

TO LOCK: Turn cap onto threads in a clockwise direction until it no longer turns. Then press down cap and turn to seal.

KEEP DRAINS OPEN: Every week remove drain sieve. Keep bottle away from face at all times. Use 1/4 bottle. Let stand 10 minutes. Flush with hot water from faucet.

OPENING CLOGGED DRAINS: Remove sieve and any standing water from sink, washbowl, or tub. Keep bottle away from face at all times. Use 1/2 bottle. Allow to work 30 minutes. Flush with hot water when drain clears. Repeat if necessary. For tough jobs, let stand overnight before flushing with hot water. Keep face away from drain.
The two labels in Figures 7 and 8 follow this outline. Ingredients might be listed on the “front” part of the label. The above largely concerns the “back” part of the label.

In addition to this hierarchical ordering, the organization of the label attempts to facilitate processing in other ways. Benefits and risk information are each collected in one place, and the two types of information are put next to each other so that the consumer can more easily make the tradeoff between risks and benefits at the point of purchase. As mentioned previously, consumers have difficulty with trading off risks with benefits. Making such tradeoffs easier could affect the purchase rates of generally hazardous products.

We have also graphically linked the possible dangers in use with the recommended actions to avoid these dangers, using boxes and arrows. For example, in Figure 7, consumers are told of the potential hazard that the product could release hazardous gases if mixed. The consumer is then given specific instructions on how to avoid such a hazard. Use of such specific, concrete actions is more readily understandable. This information is formatted to maximize its ease of application at the time of product usage. We feel that it is crucial to have very clear usage guidelines on the label itself, which almost always is available when the consumer tries to use the product. Finally, we have placed the antidotes at the bottom of the label due to our (weak) opinion that this is the location most consumers first look for such information. Even if this is not the place consulted first currently, consumers will soon learn that this is where the information is located if our labeling standard is adopted. Note that we have not tried to be parsimonious about providing information, under the belief that some redundancy is beneficial.

In addition to the use of graphical devices (arrows and boxes) to organize information for the consumer and direct processing to some extent, we have used symbols to communicate risk hazard levels. While one could use more extensive symbolic systems such as those shown in Figure 6, we felt that use of the familiar skull and crossbones sign for danger represented a reasonable initial proposal. Further details could always be added if necessary.

These design considerations implement the general principles (a)-(g) discussed earlier. However, principle (h), providing information in a relative or comparative format, has not been addressed. We feel that it is highly desirable to show the range of hazard which other products suitable for the same application possess. That is, we would like to communicate something like “This product has level 4 of risk on contact. Other products which could be purchased that accomplish the same application range from 2 to 4 on this hazard.” Figure 6 provides one example of a scale designed to do this; similar systems are used for automobile mileage ratings and energy usage. We would like to provide such comparative ratings symbolically for risks, but we are unsure whether it is feasible (due to multiple application for a single product) or how best to do it. Because of these complications, we did not implement this part of the system at this time. In addition, such comparative information is better provided in a point of purchase display. However, if such displays are not used, some further consideration should be directed as to how to best provide comparative information on the label.

Implicit in the sample labels given is a list of hazards to be presented and a rating scheme for scaling those hazards. As shown in Figures 7 and 8, we have used hazards from swallowing (ingestion), contact, breathing (inhalation), and flammability. While we have provided a scheme using four
Designing Effective Labels

hazards and have used a scale with five degrees of hazard (none to four skull and crossbones symbols, with more symbols implying greater hazard), such determinations of the hazards to include and the scale values are not within our range of expertise. The scheme shown in Figures 7 and 8 is strictly for illustrative purposes, and technical authorities would need to be consulted regarding measurements and other facets involved in the design of a rating system.

Even with these caveats about the symbolic hazard section of the label, we feel strongly about the general concept of symbolically presenting hazard levels on specific dimensions. In developing this scheme for presenting hazard (risk) information, we made the decision to concentrate on the severity of consequences if the product is misused (e.g., what happens if it is ingested). Thus, we do not consider risks remaining if the product is used safely or the probabilities of the various hazards occurring. We did this for two reasons. First, to best protect consumers from harm, we felt they should be notified of potential hazards. Knowing that a product can be dangerous if used improperly should motivate more careful usage. However, our label does not communicate residual risks that remain even if the product is properly used. Government agencies usually adopt bans rather than labels if such residual risks are serious. Also, since people have a very difficult time processing probabilistic information and individuals tend to focus on severity as long as probabilities are above some minimum cutoff level, we have focussed on severity and provide no frequency information on the label. Only hazards whose probabilities are above a given cutoff should be included on the label. Perhaps package inserts could provide probability levels, but we felt such estimates would be too confusing to put on the label itself.

Note that the label contains information on several components of risk and no summary measure of risk. Consumers may have problems integrating several risk measures [Svenson 1985]; however, as noted above, summary measures also can be troublesome [Russo et al. 1985]. The issue of integration of multiple types of risk is an important area for research.

We have handled effects on special populations implicitly rather than explicitly. If the product is hazardous to a special population group and this group is large enough to merit protection via a label, then the hazard rating on the label should reflect the level of hazard to that population rather than to the average user. Again, this is consistent with our emphasis on communicating the most serious potential hazard. Hence, one would reflect the hazard level (and possibly mention particular populations on the label) only if the subpopulation were reasonably large (e.g., children) or if the dangers were especially severe for this subpopulation (e.g., a potentially fatal allergic reaction).

In dealing with long-term effects of chemicals, such as carcinogenicity, we were less certain how to proceed. We decided not to include long-term effects in our list of hazards, since we perceive that there are severe measurement problems associated with such a dimension. However, if regulatory agencies can measure long-term effects and are willing to rate each chemical on this dimension, then such effects should be included in our symbolic hazard section.

A second alternative for handling long-term risks is to include a brief verbal statement such as the one included on cigarette packages. It is our belief that such a statement would be less effective than our symbolic rating scheme, but we recognize the difficulty of rating the long-term effects of a product on a person’s health due to the existence of numerous intervening
variables. Thus, if the regulatory agency believes verbal statements are the only feasible way politically and/or technically to quantify long-term risks, we would still suggest such information be included in the hazard section.

A third option, and the one we implicitly assumed in our examples, is that any such long-term effects are incorporated into the basic rating scheme for each hazard shown on the label.

In summary, we feel that long-term hazards are really a measurement issue which requires technical expertise and are not a design issue. Our label can display the long-term hazard information if it can be quantified.

Finally, we must mention that our label requires each producer to allocate a substantial amount of label space for hazard information. Label space is often limited; thus our standard format might drive out other label information, such as product benefits or potential uses of the product. We have analyzed the space allocation of our labels for a liquid drain cleaner and a bleach. The total amount of label space (total area of label) for our bleach labels and for other actual labels (e.g., Figures 1 and 2) was approximately the same. However, we do devote a greater percentage of that space to risk information: 69 percent for our label, versus 41 percent for Bright, and 31 percent for Clorox. For drain openers, however, our label used 63 percent of the available space for risk information versus 78 percent in an actual label. Thus, it is not always the case that our label will require more space allocation for risk information.

Package Inserts Package inserts can be used to provide detailed information at the point of usage. Since the insert is not as constrained by space limitations as the package label, more detailed information can be given. However, since the insert can become lost, particularly for products which are used multiple times, we feel that the label must have the major burden for communicating essential usage instructions. Hence, the function of the package insert may be to provide details on how to best gain the benefits of the product, with the label providing information on how to avoid the risks. The insert could also provide more details on the risks and on usage instructions. However, everything essential about risks and proper usage should be communicated on the label.

Conclusion The labeling system described above provides an example of a system for providing information based upon an understanding of human information processing limitations and characteristics. Such considerations are exceptionally important in designing labels and other components of the system. Information must not only be made available, but processable. If processability is ignored, information related to hazards may not be utilized. Such failure to process information about risks can have substantial negative consequences. Providing risk information in a form which will enhance its processability can thus lead to great societal benefits, which can then be compared to the costs of such information provision.
References


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