Journal of Risk and Uncertainty, 1: 201–232 (1988)


# Consumer Processing of Hazard Warning Information

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**Key words:** consumer processing, hazard warnings, memory recall, product labeling

## *Abstract*

Using data obtained from a field experiment involving 957 consumers, this study investigates the linkage between hazard warnings and precautionary behavior, as well as the structure of the information about product usage and risks that consumers store in their memories. Through the use of a methodology based on an open-ended memory recall task, we measure how consumer recall of information on product labels is affected by the type and format of the information and infer the structure by which this information is stored in their memory. The methodology also allows us to explore the importance of limitations on consumers' cognitive abilities. In particular, we find that consumers substitute greater recall of risk information for recall of usage information, indicating a tradeoff among the different types of information conveyed on a product label. We also found that in the case of cluttered labels, as typified by many existing product labels, information overload results, which may make labeling ineffective in achieving its intended informational objective.

A common source of market failure in product markets and job markets is that individuals do not have full information concerning the risks they face. In the product market context, this inadequacy causes two principal problems. First, inadequate information distorts the mix and amount of products that consumers purchase, which in turn affects firms' incentives to produce safe products. Second, after purchasing the product, consumers may not take the appropriate precautionary actions. It is this latter impact of imperfect information that will be our focus in this paper.

A natural remedy for imperfect knowledge is to provide consumers with additional pertinent information. This remedy holds considerable appeal among economists since it addresses the source of the market failure directly, while at the same time preserving the constructive aspects of markets. Government agencies

have also displayed increasing reliance on information as a regulatory alternative since labeling is a less obtrusive action than a product ban.

Information policies represent the efficient solution to problems of inadequate information only if the informational inadequacy stems from shortcomings in the information provided to the individual, rather than limitations on his or her ability to process and act upon the information. The standard economic model assumes that consumers are fully rational and that they possess all the relevant information about products, including the risks of using them. An alternative possibility is that consumers are not fully rational. In its most extreme form, their actions may be unaffected or even adversely affected by additional risk information, and they are less able to process the hazard warnings reliably or make sound decisions.

In an earlier field experiment reported in Viscusi and Magat (1987), we found that properly designed labels boost consumers' intentions to take safety precautions, which is consistent with the hypothesis that hazard warning programs can alleviate market failures due to informational inadequacies. In this study we use memory recall techniques to explore the cognitive processes which were not measured in the earlier study.

This approach does more than provide an alternative perspective on the information-precautions linkage. The memory recall methodology enables us to explore an additional class of issues that arise because of limitations on human processing capabilities. Our experimental results will suggest that hazard warning programs convey risk information, but at a cost. Consumers in our study traded off increased recall of risk information for decreased recall of product usage information. In the extreme case of cluttered labels, more than the mix of information may be at stake. Overloading consumers with risk information obscured the underlying message of the hazard warning.

Our recognition of the importance of cognitive factors in analyzing economic behavior has a number of precedents. It is now well accepted that people have limits on the amount of information that they can process. Thirty years ago Simon (1957) theorized that individuals possess "bounded rationality." More recently, Bettman (1979, p. 177) concluded in his review of the relevant literature that, "In general, consumers do not have the resources or the abilities necessary to process the total amount of information which might potentially be available for making any particular choice . . . Consumers have limited processing capacity."

The literature on information processing identifies the presence and extent of external memory, or information outside consumer's memories, as an important characteristic of consumer choice tasks (Bettman, 1979). Labeling can provide an important source of external memory in situations where inefficient consumer decisions are caused by lack of adequate information about products, rather than problems in processing information. Even in situations where information processing limitations create the inefficiencies, external sources of information can help by formatting information in ways that make processing easier for the consumer.[1]

This article develops a methodology for analyzing how consumers respond to information about risks and precautions on product labels. Thus, our study adds an additional focus, arising from the probabilistic nature of the outcome, to those studies investigating the difficulties posed by information processing under complete certainty. This generalization is likely to be of fundamental consequence, since there is a substantial literature indicating that uncertainty poses additional and novel problems for individual decisions.

We focus upon product labels because they represent an important and frequently used class of information policies, and because there is evidence that their effectiveness can be significantly improved.[2] Examining product labels also allows us to test hypotheses about consumer responses to information provision that are relevant to most other information policies, such as safety training programs and public service advertisements.

Our approach relies upon placing a sample of consumers in an experimental setting in which they are asked to recall information from the label on a product that they had been given to examine. It turns out that consumer recall of information on hazardous products is highly sensitive to the amount, type, and structure of the information on product labels. Thus, to the extent that differences in memory recall translate into differences in indicated precautionaray behavior, this methodology allows us to test the relative effectiveness of different labels in influencing economic behavior towards risk.[3]

We apply the unstructured memory recall approach to three research questions, thus enabling us to explore the role of cognitive factors in detail. First, what is the structure of consumer memory with respect to the information on existing consumer product labels? By analyzing labels patterned after two existing hazardous chemical products, a toilet bowl cleaner and a garden insecticide, we measure the amount of the information on the labels that consumers recall with and without prompting and the types of information that they remember (such as how to use the product or what precautions to take in using it). The approach also provides measures of the order in which information is recalled from memory, such as which types of information are recalled early, which are recalled late, and which types of responses are triggered by the recall of other types of responses. These data allow us to infer how the product information is stored in memory. This knowledge about the structure of memory should be useful in the design of effective labels because, as Bettman (1979, p. 223) concludes, "Preorganization of data can aid processing, but only if organization is congruent with the consumer's organization in memory . . . "[4]

Our second research question has two parts. Does consumers' reading of labels affect their learning about the risks of product use and the precautions they should take? If so, what is the magnitude of the increase in their recall of risk and precautions information due to reading the labels? Because most consumers either regularly use or are familiar with products such as toilet bowl cleaner and insect spray, even without providing any information about risks and precautions, we would expect them to know many of the risks and precautions associated with the

products. To measure the effect of labeling information, one must first establish this level of baseline knowledge and then examine the incremental increase in knowledge above the baseline.

The third research question explores one example of how existing labels might be made more effective. Specifically, we examine whether adding a large amount of information to a label can cause consumers to recall less of the information on the label than if a less cluttered label were used. Academics have long theorized about the contexts in which information overload can occur, and in recent years several tests of the hypotheses have been carried out (Gaeth & Shanteau, 1984). Manufacturers of consumer products are also concerned with the possibility of information overload because regulatory agencies are requiring them to include more and more information on labels, a practice they fear will make the labels less effective as a communication instrument. By comparing recall of information from two labels that differ only in the amount of information they contain, we test this clutter hypothesis.

The next section briefly reviews the literature on the phenomenon of information overload. Section 2 describes the memory recall methodology we use to infer how consumers will respond to different types of labels, while section 3 characterizes the data base of responses to our memory recall interview. In section 4, we analyze the order of responses to labels patterned after existing products, providing an understanding of the hierarchy consumers use to recall information on hazardous chemical labels.

Section 5 examines the differences in the amount and type of recall from several alternative labels on two chemical products. These comparisons address the question of how much recall of risk and precautions information is improved by placing it on product labels and the question of whether cluttering labels with large amounts of information of minor importance to consumers contributes to information overload. Finally, section 6 summarizes our conclusions from the study.

## 1. Information overload

As was noted above, informational remedies to information-based market failures will only be effective if the inefficient decisions made by consumers are due to lack of adequate information, rather than their inability to process it. This distinction is particularly important for the design of product labels because if processing limitations create the problem, then adding additional information to labels may worsen rather than improve the situation.

Some authors have theorized that due to these processing limitations, consumers may become overloaded with information and respond to the additional information by making worse decisions. Jacoby, Speller, and Kohn (1974) and Jacoby, Speller, and Berning (1974) presented the first set of empirical results that they claimed demonstrated the existence of information overload.

Several authors immediately challenged these findings, both on the study

design and on the analysis and interpretation of the data.[5] By the end of the decade, Bettman (1979, p. 206) was forced to conclude that "Whether information overload occurs and hinders consumer choices is still an open issue." More recently, Malhotra (1982) reported a new study of housing choices designed to overcome the major conceptual and methological criticisms made of the Jacoby et al. studies, finding significant evidence of information overload caused both by providing consumers an excessive number of alternatives (ten or more) in their choice set and by giving them an excessive number of product attributes (15 or more).

Only a year later, Grether and Wilde (1983) reported on another study that asked students to select among lotteries, which they claim is analogous to choosing among products with multiple attributes. A substantial majority of their subjects were able to select undominated lotteries, even when the number of alternatives was large and when the number of attributes of each lottery (i.e., possible outcomes) was high. Grether and Wilde (1983) did find evidence of poor decision making in their study, but only when subjects appeared to be required to *use* a large amount of information. With just the *presence* of excessive amounts of information, subjects were able to ignore unnecessary or unwanted information. In a subsequent paper, Grether, Schwartz, and Wilde (1985) concluded that consumers are often able to use familiar, simplifying strategies for overcoming task-choice problems, and thus that information overload is a myth that should be irrelevant to public policy concerns.

By contrast, work in psychology (see Graeth and Shanteau, 1984) has found that irrelevant information increases the time required to do tasks and that there are strong differences between individuals in their ability to correctly cope with irrelevant information. The idea that irrelevant information increases the time to do the task is important because it suggests that under a time constraint tasks with irrelevant information will be done less accurately. The finding of Graeth and Shanteau (1984) that individual differences matter indicates that the negative impact of labels with irrelevant information will fall disproportionately on those members of society who are least able to process information.

Given the contradictory nature of the results reported above, Keller and Staelin (1987) designed a new study based on a new measure of consumer decision-making ability which they call *decision effectiveness.* This variable measures the difference between the utility of the consumer's ideal choice and the utility of his actual choice, given the limited information environment. They also distinguish between the *quantity* of information available to a consumer and the *quality* of that information, hypothesizing that a higher quantity of information affects decision effectiveness adversely while higher information quality improves decision effectiveness. Using a sample of job choices by MBA students, they offer empirical evidence that supports both of these hypotheses.

Note that in all of these studies the ability of consumers to recall information was not at issue because all the information provided in the experiments was permanently available to subjects. Certainly, accurate recall of information is helpful for making good decisions. Thus, one reason for the degradation in the ability of

consumers to make good purchase and product-use decisions may be their difficulties with recalling information from memory, independent of any problems with processing that information. Even if one agrees with the Grether, Schwartz, and Wilde (1985) findings that excessive information does not generally overload consumers when that information is made easily available to them, it is still possible that information overload may occur because of recall problems. In addition, the optimistic results of Grether, Schwartz, and Wilde (1985) may be attributable to the use of more structured experimental stimuli than will be encountered in actual information transfer contexts. For this reason, we have designed an experiment linked to actual forms of information encountered by consumers to test whether cluttering product labels with excessive information can adversely affect the ability of consumers to recall important information from labels. Thus, while our study represents a survey experiment, it was undertaken using a market-based context involving information of the type now provided on these products and regular consumers of that class of products. When making inferences about actual economic behavior, we will consequently have to make much weaker assumptions than if our study had been based on student responses to a more hypothetical task.

## Methodology

For product users to respond to the information on labels—for example, in taking precautions to avoid injuries—the users must first remember the precautions, then attend to follow them, and, of course, they must follow through on those intentions. If one could implement a field experiment in which products with different labels were purchased and subsequently used in the home, then observing differences in precautionary behavior across labels would provide the best assessment of labeling effects. However, besides being costly and time-consuming, it may be impossible to measure consumer precaution-taking in a way that did not bias behavior. If product users are required to self-report precautionary actions, or their behavior is observed by cameras or researchers in their homes, then their behavior could be biased towards taking more precautions. Accurate recall of the precautions taken would also be difficult, and the more often researchers asked for recall of behavior the greater would be the bias from the demand effect.

If demand effects could be eliminated, the next best approach to studying precautionary behavior would be to measure user *intentions* to take precautions, as in Viscusi and Magat (1987). This approach assumes that the link between intentions to take precautions and actual behavior does not differ systematically across labels. Because of the critical need to keep subjects unaware of the purpose of questions for fear of creating demand effects that cause them to overstate their true intentions, only a limited number of questions can be asked of each subject, and the questions must be carefully disguised. For example, in our previous study (Viscusi and Magat, 1987) we employed this technique to find out whether subjects

would store chemical products in a childproof location, but we approached the problem by first asking them where they would store the product and then probing indirectly until learning whether that location was out of the reach of children.

In this study we measure unaided *recall* of precautionary information, rather than intentions to take precautions or actual use behavior. This approach greatly reduces the potential problems from demand effects, allows a much richer and more extensive set of questions to be asked of each subject, and provides a high degree of discrimination among the effects of different product labels.

In this study we measure unaided recall through unstructured questions. This approach contrasts with the common use of structured questions and responses. These are easy to administer and analyze, and they provide easily communicated, reproducible results. However, in analyzing the impact of labels on memory, structured questioning may impose the questioner's structure on the memory recall. Avoiding this confounding factor is particularly important when one is interested in uncovering the hierarchical structure in memory, one of the purposes of this paper.

There are several reasons to expect that the amount of recall of information from labels will be strongly associated with the extent of precautionary behavior. For the two products analyzed in this study, toilet bowl cleaner and garden insecticide, one would not expect consumers generally to reread the precautions and risk information on the labels every time they use the products, because these products are used frequently, and their hazards are not so severe as to cause undue concern about exposure to the products. Even if consumers do refresh their memories by rereading the product labels, to the extent that the first reading of the label induces better memory of information on the label, subsequent readings should also induce memory of more information.

Further, Magat and Viscusi (forthcoming) provide empirical evidence showing that consumer recall of label information is closely related to their precaution-taking intentions. In a separate analysis we have also established a strong link between precautionary intentions of experimental subjects and actual precautions by individuals who use products with labels similar to the experimental labels. Thus, the implications of the recall data are likely to be strongly related to precautionary intentions and actual behavior.[6]

To avoid the problems with structured questions about memory, we designed an open-ended questioning process that elicited the subject's recall of the information on the product label in a way that revealed both the information the subject remembered and the order in which he or she recalled that information. Despite its advantages, open-ended data are notoriously difficult to decode and analyze (Kassarjian, 1977). In the verbal protocol approach, transcripts of responses need to be recorded, then typed, and finally coded by judges. Partially as a result of these difficulties, most studies using protocol analysis have used a small number of subjects, a research strategy that reduces the statistical power of the tests performed on the data.

To be able to handle free responses from a large number of subjects, in our study

he interviewers directly coded the free-response data by placing the responses nto categories as the interview progressed. This technique enabled us to carry out lmost 1000 interviews at a reasonable cost. There were, however, a number of teps needed to develop a coding sheet and to train the interviewers to use the :chnique.

Our interviewers intercepted shoppers in either a shopping mall or a hardware tore in Greensboro, North Carolina and brought them to a quiet area for the in-:rview. The interviews took place in 1985. Subjects were first screened to ensure iat they were over 21 years old, could read, and had used at least one of the two onsumer chemical products under study over the past year. Then the interviewer howed them one of the two products in a container used for that class of product. 'his test bottle had a professionally composed, colored label comparable to those laced on similar products sold in stores. Although the product names were fic-tious, all other aspects of the product, its container, and its label closely matched ie analogous products sold commercially.

The subjects were given the instructions to examine the new product "as if you re about to use it *for the first time,*" (emphasis in original) and then provided two iinutes to look at the product. An additional research issue that we did not ad-ress is whether different kinds of labels lead individuals to work harder by spend-ig more time reading the label. Our study focuses on the efficacy of a fixed time )nstraint, where this time allotment should be adequate for most consumers.

After reading the labels the product was moved out of sight and respondents ere asked; "Suppose a friend of yours has never used this kind of product before. xplain to me the directions you would give to your friend about the proper use of he product)." Further prompting was then limited to "Are there any other instruc-ons you would give to your friend?" Through extensive pretesting we discovered iat this question and the associated prompting worked well in eliciting recall of ie information on the label.

The coding sheets are shown in figures 1 and 2. These forms began in substan-ally shortened form, containing only portions of the information on the labels. hrough a series of pretests, new possible responses were added and various :hers were consolidated. The open-ended categories on the sheet permitted us to ieck for common responses and change the categories accordingly. Five cate-)ries of possible responses evolved—Directions for Use (Uses), How Can it Hurt ou? (Hurts), Actions to Take (Do's), Actions to Avoid (Don'ts), and Antidotes. All sponse categories other than the Uses category were risk-related. The process of :veloping the coding sheet was not an easy one, requiring about 100 interviews r each product class before settling upon the final form for the coding sheets. Interviewers were instructed to record the order number of the open-ended sponse—1 for the first response, 2 for the second one, and so on. Because the in-rviewer was required to simultaneously record the particular response and its 'der, substantial training was necessary. For their training, interviewers learned e possible responses and practiced interviews on each other. Then each inter-ewer conducted interviews with a supervisor present. Since the interviewers had

*Questions About the Toilet Bowl Cleaner Usage*

SUPPOSE A FRIEND OF YOURS HAS *NEVER* USED THIS KIND OF PRODUCT BEFORE. EXPLAIN TO ME THE DIRECTIONS YOU WOULD GIVE TO YOUR FRIEND ABOUT THE PROPER USE OF CONQUER.

*DIRECTIONS FOR USE*

PART 1 PROBE: ARE THERE ANY OTHER INSTRUCTIONS YOU'D GIVE YOUR FRIEND?

- _ LIFT SEAT (A)
- _ SQUIRT (A)
  - _ 15 SECONDS (A)
  - _ 4 OZ. (A)
- _ LET STAND (A)
  - _ 10 MINUTES (A)
  - _ LONGER IF STAINED (A)
- _ BRUSH (A)
- _ FLUSH (A)
- _ REPEAT IF NECESSARY (A)
- _ RINSE BRUSH (A)
- _ DEODORIZES (A)
- _ USE REGULARLY (A)
- _ CLEANS AND DISINFECTS (A)
- _ SAFE FOR PLUMBING (A)
- _ OTHER (A)

_____

| *DON'T...* (PART 2 PROBE: "WHY?" | *HOW IT CAN HURT YOU* (PART 2 PROBE: "IS THERE ANY OTHER THING YOU WOULD SAY SO YOUR FRIEND WOULD AVOID THIS PROBLEM?") | *DO...* (PART 2 PROBE: "WHY?") |
|---|---|---|
| USE IT AT ALL (B) | POISONOUS (O) | _ WASH HANDS AFTER USE (MM) |
| _ SWALLOW/EAT/DRINK (C) | DANGEROUS (KK) | _ BE CAREFUL IN GENERAL (W) |
| _ BREATHE FUMES (D) | | _ KEEP IN CHILD-PROOF LOCATION (X) |
| _ GET IN EYES (E) | _ HARMFUL IF SWALLOWED (P) | _ READ LABEL (LL) |
| _ SPLASH WHEN USING (F) | _ EYE INJURIES (Q) | _ KEEP IN LABELLED BOTTLE (Y) |
| _ GET ON FACE (G) | | _ USE SAFETY CAP (AA) |
| _ GET ON SKIN (H) | _ SKIN DAMAGE (R) | _ WEAR GLASSES (BB) |
| _ GET ON CLOTHES (I) | | _ STAND AWAY FROM BOWL (CC) |
| _ TOUCH AT ALL (J) | _ TOXIC GAS POSSIBLE (S) | _ WEAR GLOVES (DD) |
| _ MIX WITH BLEACH (K) | | _ USE BRUSH (EE) |
| _ MIX WITH ANYTHING (L) | FLAMMABLE (T) | _ WEAR SMOCK (FF) |
| _ GET ON COUNTER (M) | | _ USE IN WELL VENTILATED AREA (GG) |
| _ OTHER (SPECIFY) (N) | _ CORROSIVE (U) | _ CLOSE DOOR (HH) |
| | | _ USE ONLY FOR TOILET BOWLS (II) |
| | OTHER (SPECIFY) (V | _ OTHER (SPECIFY) (JJ) |

_____

| ANTIDOTES: | | |
|---|---|---|
| _ DRINK MILK OR WATER (Z) | FLUSH EYES (Z) | CALL PHYSICIAN (Z) |
| _ RINSE MOUTH (Z) | _ 15-30 MINUTES (Z) | OTHER (Z |
| _ FLUSH SKIN (Z) | _ INDUCE VOMITING (Z | |
| _ 15-30 MINUTES (Z) | _ DO NOT INDUCE VOMITING (Z) | |

*Questions About the Insect Spray Usage*

SUPPOSE A FRIEND OF YOURS HAS *NEVER* USED THIS KIND OF PRODUCT BEFORE. EXPLAIN TO ME THE DIRECTIONS YOU WOULD GIVE TO YOUR FRIEND ABOUT THE PROPER USE OF ZINBRYL (FOR PRIMARY USE GIVEN ABOVE.)

(*DIRECTIONS FOR USE*

(PART 1 PROBE: "ARE THERE ANY OTHER INSTRUCTIONS YOU WOULD GIVE TO YOUR FRIEND?"

__ USE 2-3 TEASPOONFULS (A)
__ USE FOR FLEAS/ANTS (A)
USE LARGER DOSE FOR FLEAS (A)
__ USE MOST INSECTS (A)
USE FOR ORNAMENTALS (A)
__ USE FOR VEGETABLES (A)
__ USE FOR FRUIT TREES (A)
__ SPRAY ALL PLANT SURFACES/ SPRAY EVENLY (A)
__ USE SPRAYER (A)
__ DILUTE/MIX WITH WATER (A)
__ REPEAT AS NECESSARY (A)
__ USE BEFORE HARVEST (A)
DON'T USE BEFORE HARVEST (A)
OTHER (SPECIFY) (A)
_____
_____

*DON'T . . .*
(PART 2 PROBE: "WHY?")

__ USE IT AT ALL (B)
__ SWALLOW/EAT/DRINK (C)
__ USE NEAR FOOD (NN)
__ PUT IN FOOD CONTAINERS (D)
__ STORE DILUTED SPRAY (E)
__ REUSE EMPTY CONTAINER (F)
BREATHE VAPORS OR
__ SPRAY (G)
__ MIST
__ GET IN EYES (H)
__ USE WHEN WINDY/ SPRAY INTO WIND (I)
GET ON SKIN/FACE (K)
__ GET ON CLOTHES (L)
TOUCH AT ALL (M)
__ USE BEFORE HARVEST (OO)
GET IN LAKES, PONDS (N)
WATER SUPPLY
USE FOR OTHER THAN

*HOW IT CAN HURT YOU*
(PART 2 PROBE: "IS THERE ANY OTHER THING YOU WOULD SAY SO YOUR FRIEND WOULD AVOID THIS PROBLEM?")

__ POISONOUS/TOXIC (P)
__ DANGEROUS (Q)
__ HARMFUL IF SWALLOWED (R)
__ (BURNS THROAT AND STOMACH)
__ DAMAGE TO LUNGS. (S)
__ BREATHING
__ EYE INJURIES (T)
__ SKIN DAMAGE (U)
FLAMMABLE (V)
__ HARMFUL TO ANIMALS/ FISH (TT)
__ ENVIRONMENTAL DAMAGE (W)
OTHER (SPECIFY) (X)
_____
_____

*DO . . .*
(PART 2 PROBE: "WHY?")

__ BE CAREFUL IN GENERAL (Y)
READ LABEL/ (AA)
__ FOLLOW DIRECTIONS
KEEP IN CHILD- (BB)
__ PROOF LOCATION
KEEP IN ORIGINAL OR
__ LABELLED BOTTLE (CC
DISPOSE OF BOTTLES
__ PROPERLY (SS)
__ WEAR GLASSES/ __ GOGGLES (FF)
WEAR GLOVES (GG)
__ WEAR PROTECTIVE CLOTHING (HH)
__ WASH SKIN AND (II) HANDS AFTER USING
__ REMOVE/LAUNDER (JJ) CONTAMINATED CLOTHING
__ KEEP CHILDREN/ (KK) ANIMALS AWAY FROM
__ TREATED AREAS
STORE IN COOL, (LL)
__ DRY PLACE

*Fig. 2.* Coding sheet for insect spray responses.

*Fig. 2. (Continued)*

INTENDED USE (PP)
OTHER (SPECIFY) (O)
_____
_____
_____

CLEAN TOOLS AFTER USE (RR)
OTHER (SPECIFY) (MM)
_____
_____

ANTIDOTES:

_ DRINK LARGE QUANTITY OF (Z) WATER

_ FLUSH EYES (Z)

_ GET MEDICAL ATTENTION (Z)

_ WASH SKIN/HANDS (Z) WITH SOAP AND WATER

_ 15-30 MINUTES (Z)
_ INDUCE VOMITING (Z)
_ DO NOT INDUCE VOMITING (Z)

OTHER (Z)
_____
_____

substantial experience, most were able to master the task; however, even with this training, some were unable to conduct effective interviews and were removed from the project.[7]

## 3. Data

To analyze how consumers respond to the information on the labels on hazardous products, we selected two consumer chemical products for study, a toilet bowl cleaner used in the home and an outdoor insect spray. Each subject received one of these two products. Although the brand names and labels on the products were fictitious, the information on the labels was patterned after the Vanish brand of toilet bowl cleaner and the Ortho Malathion brand of outdoor insect spray.

Table 1 describes the differences between the two different toilet bowl cleaner labels and the three different insect spray labels used in the study. Figure 3 displays the toilet bowl cleaner and insect spray labels. The 957 subjects were randomly assigned to labels, with roughly an equal number of subjects shown each of the five labels.

The differences in the labels were designed to address the following two questions about the effects of labels on the extent to which product users take the recommended precautions and use the products correctly. First, to what degree does the inclusion of risk and precautions information on the labels result in accurate recall of this information, and thus induce users to take the recommended precautions? And second, does adding to a label additional information that is unrelated to risks and precautions (for example, about product usage) and that clutters the label cause users to recall less of the critical information on labels? Comparing the responses to toilet bowl cleaner labels 1 and 2 and comparing the insect spray label 1 and label 3 responses allows a direct test of the effect on recall of ad-

*Table 1.* Descriptions of the Five Product Labels

*Panel A:* Toilet bowl cleaner

| Label Number | Contains Risk and Precautions Information? | Percentage of Risk and Precautions Information |
|---|---|---|
| | No | 0 |
| | Yes | 37 |

Insect spray

| Label Number | Contains Risk and Precautions Information? | Percentage of Risk and Precautions Information | Cluttered? | Risk Information Print Size |
|---|---|---|---|---|
| | No | 0 | No | Regular |
| | Yes | 44 | No | Small |
| | Yes | 44 | Yes | Small |

ding risk and precautions information to the labels. Comparison of insect spray abels 2 and 3 provides a direct test of the clutter hypothesis. The cluttered insect spray label 3 was patterned after the current Ortho Malathion label so that experimental results indicating an adverse effect of clutter will imply that current labeling efforts can be improved.

Table 2 describes the demographic and product usage characteristics of the oilet bowl cleaner and insect spray samples. None of these characteristics are particularly surprising, given the nature of the two products being considered. We did ise these demographic and usage variables as covariates in regression equations o control for differences in responses to the alternative labels caused by sample :haracteristics; however, it turns out that this adjustment has little influence on the :onclusions about the behavioral impact of labels drawn from a simple comparison of mean responses to the different labels.[8]

Before considering the impact of experimentally designed labels, it is useful to :xamine the hierarchical structure of product memory. This structure changed ery little with the particular experimental label used. The structure is, however, ielpful in explaining the pattern of responses to particular labels that will be addressed in section 5.

## Hierarchical Structure of Product Memory

he most effective labels on hazardous chemicals are likely to be those that reinorce the structure of processing information from labels that most consumers lready use, or those that reformat the information in a way that allows consumers o recall it more easily from their long-term memories. One of the major advan-

*Table 2.* Demographic and Product Usage—Means and Standard Errors

| Variable | | Insect Spray |
|---|---|---|
| INCOME (1985 $) | 36,213 | |
| | (245) | |
| AGE (years) | 37.81 | |
| | (0.51) | |
| EDUC (years of education) | 13.38 | |
| | (0.09) | |
| FAMSIZE (# in family) | 2.91 | |
| | (0.05) | |
| MARRY (1 = married, 0 = not married) | 58.06 | |
| | (1.67) | |
| CHILD (1 = children, 0 = no children) | 23.44 | |
| | (1.44) | |
| FIVE (# children < 5) | 0.28 | |
| | (0.02) | |
| KIDS (# children between 5 and 18 years old) | 0.58 | |
| | (0.03) | |
| SPOUSE'S EDUC (years) | 13.28 | |
| | (0.07) | |
| | 15.20 | |
| | (1.21) | |
| WORK (1 = works outside home, 0 = no) | 66.86 | |
| | (1.59) | |
| USECHEM (1 = uses chemicals on job, 0 = no) | 30.49 | |
| | (1.57) | |
| TRAINED (1 = professional training in interpreting labels, 0 = no) | 17.42 | |
| | (1.29) | |
| YEARUSE (quarts/year) | 6.25 | |
| | (0.27) | |
| LASTUSE (# months since last use) | 0.98 | |
| | (0.08) | |
| PRIMUSE (primary use, with 1 = yes, 0 | | |
| a) Ornamental trees | | 41.6 |
| | | (1.66) |
| b) Fruit trees | | 7.72 |
| | | (0.88) |
| c) Vegetable plants | n/a | 23.44 |
| | | (1.41) |
| d) Controlling fees | | 27.24 |
| | | (1.49) |
| FARMER (1 = yes, 0 = no) | | 6.02 |
| | | (0.81) |

Note: n/a mean not applicable.

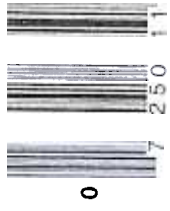
# CONQUER

TO DISINFECT AND CLEAN: Raise toilet seat. Direct CONQUER inside bowl, including under the rim, on the sides, and into the water. To kill household germs, including staph and strep, use at least 4 oz. (squeeze approximately 15 seconds). Leave CONQUER in bowl for 10 minutes, then brush and flush. Rinse bowl brush in fresh water after use.

TO REMOVE STUBBORN STAINS: For hard water stains, follow directions above. Then apply more product directly to stained areas. Let CONQUER stand at least 15 minutes, brush and flush. Repeat if necessary.

Regular use of CONQUER keeps toilet bowls sparkling white. CONQUER is excellent for brightening colored toilet bowls. Harmless to plumbing and septic tanks.

| Active Ingredients: | |
|---|---|
| Hydrogen Chloride | 9.25% |
| n-Alkyl (60%C14,30%C16,5%C12,5%C18) dimethyl benzyl ammonium chloride | 0.30% |
| n-Alkyl (50%C12,30%C14,17%C16,3%C18) dimethyl ethylbenzyl ammonium chloride | 0.30% |
| 1-(2-Hydroxyethyl)-2 heptadecenyl imidazolinium chloride | 1.60% |
| Inert Ingredients | 88.55% |



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Marshfield, Wisconsin 54449
U.S.A. Distributor
Questions about CONQUER? Toll Free 1-800-684-6671

*Fig. 3.* Back panels of labels used in the study.

*Panel A:* Toilet bowl cleaner label #1—contains no risk and precautions information

# CONQUER

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

TO DISINFECT AND CLEAN: Raise toilet seat. Direct CONQUER inside bowl, including under the rim, on the sides, and into the water. To kill household germs, including staph and strep, use at least 4 oz. (squeeze approximately 15 seconds). Leave CONQUER in bowl for 10 minutes, then brush and flush. Rinse bowl brush in fresh water after use.

TO REMOVE STUBBORN STAINS: For hard water stains, follow directions above. Then apply more product directly to stained areas. Let CONQUER stand at least 15 minutes, brush and flush. Repeat if necessary.

Regular use of CONQUER keeps toilet bowls sparkling white. CONQUER is excellent for brightening colored toilet bowls. Harmless to plumbing and septic tanks.

CONQUER should be used only for toilet bowls.

STORAGE & DISPOSAL: Store out of reach of children. Clean up spills right away. When bottle is empty, rinse and discard.

**PRECAUTIONARY STATEMENTS**

DANGER: MAY BE FATAL IF SWALLOWED. DO NOT BREATHE VAPOR OR FUMES. MAY PRODUCE CHEMICAL BURNS TO SKIN AND EYE DAMAGE. DO NOT GET IN EYES, ON SKIN, OR ON CLOTHING. CORROSIVE TO METAL. PHYSICAL & CHEMICAL HAZARDS: NEVER USE WITH CHLORINE PRODUCTS . . . can react to give chlorine gas. If gas forms, flush toilet to remove chemicals and leave area. Do not return for half hour . . . ventilate if possible. Never use or mix with other cleaners and chemicals.
IMMEDIATELY GIVE FIRST AID: **THEN** CALL PHYSICIAN.
IF SWALLOWED: Rinse mouth. Drink one glass of milk or water. DO NOT INDUCE VOMITING.
EYES & SKIN: Flush with water for 15-30 minutes.

**Active Ingredients:**

| | |
|---|---|
| **Hydrogen Chloride** | **9.25%** |
| **n-Alkyl (60%C14,30%C16,5%C12,5%C18) dimethyl benzyl ammonium chloride** | **0.30%** |
| **n-Alkyl (50%C12,30%C14,17%C16,3%C18) dimethyl ethylbenzyl ammomium chloride** | **0.30%** |
| **1-(2-Hydroxyethyl)-2 heptadecenyl imidazolinium chloride** | **1.60%** |
| **Inert Ingredients** | **88.55%** |

EPA REG. NO. 9879-89 EPA EST. 8798-WI-2

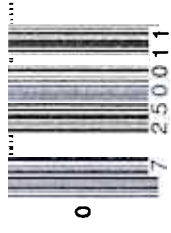




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*Fig. 3. (Continued)*

*Panel B:* Toilet bowl cleaner label #2—patterned after Vanish brand label

**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.

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Insect Spray Product Division
Clayton, N. J. 08312
Form 9899-RZ Product 8492 Made in U.S.A.

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## Insect Spray

*Panel C*: Insect spray label #1—contains no risk and precautions information

*Fig. 3. (Continued)*

## 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.

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**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.

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**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.

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## 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 9899-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

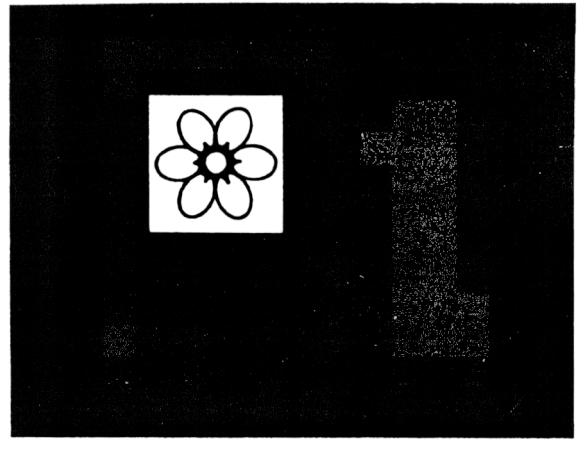

Fig. 3. (C
abel #2—1

*Panel E:* Insect spray label #3—patterned after Malathion brand label

*Fig. 3. (Continued)*

## 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, Canaerti 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 Psyllid, 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 Riber 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, Lime)—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) 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.

**HOUSE FLIES: Around Dwellings (outside only), Outbuildings, Chicken Houses, Stables, Dog Kennels, Patios, Garbage Containers—SPRAY APPLICATION**: 6 Tablespoonfuls (3 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. Maintain sanitary conditions around barns, outbuildings and other areas to prevent fly breedings.**

**HOUSEHOLD PESTS: Clover Mites around outside dwellings and lawns**—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**—9 Tablespoonfuls (4½ 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. Wrap container and put in trash collection.

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

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Insect Spray Product Division
Clayton, N.J. 08312
Form 9899-RZ Product 8492 Made in U.S.A.
EPA Reg. No. 978-725-ZX
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Superscript used is first letter of lot number.

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## Insect Spray

tages of the open-ended approach is that it allows us to infer the hierarchical order of the information in long-term memory as well as the relative importance of different pieces of information. This section explores how consumers recall the information on the existing labels for toilet bowl cleaner and insect spray, revealing a general pattern to the structure of their recall with minor variations across the two products.[9]

Although both products are hazardous chemicals used frequently by consumers, they do differ in three important ways that ought to affect the hierarchy in which the information on their labels is recalled. First, the toilet bowl cleaner label for the existing product (label 2) devotes a smaller fraction of its space, 37%, to information about precautions and risks (Do's, Don'ts, and Hurts) than does the insecticide label on the existing product (label 3), which allocates 44%. Second, toilet bowl cleaner is a less hazardous product than outdoor insect spray. Finally, the insect spray label contains much more information than the toilet bowl cleaner label, especially about precautions. For all three reasons, we would expect the insect spray label to induce a higher proportion of precautions and risk responses, and a lower fraction of uses responses, than the toilet bowl cleaner label.

As discussed below, we find this pattern to emerge in the responses to the labels on the two products. But more important, with this one exception both labels elicited approximately the same pattern of responses from the open-ended question. In describing how to use the product to a friend, and presumably in order of importance to the user, consumers generally start by recalling Uses or Uses and Do's, then they recall Do's and Don'ts, then Hurts, which evoke mostly other Hurts, Don'ts, and Do's, and finally they mention Antidotes. This recall pattern generally accords with what one would expect. Consumers first recall the overall function and manner of use, and then they recall the risks and the associated precautions.

To discover this pattern of recall, we analyzed the responses to the *existing* labels (toilet bowl cleaner label 2 and insect spray label 3) in several ways. Table 3 reports the means of the first response when divided into the five categories, as well as the means of the first two responses. For toilet bowl cleaner, consumers generally recall the Uses first (74.5% of the first response and 77.6% of the first two responses, respectively), followed far behind by Do's (20.9% and 15.6%), whereas for insect spray consumers first recall both the Do's (53.7% and 44.1%) and the Uses (24.3% and 28.4%).

Table 4 provides a similar classification, splitting the total set of responses into those in the first half of a subject's responses and those given in the second half of the responses. Again, the first responses for the existing toilet bowl cleaner product (label 2) are dominated by Uses (82.7%), with Do's a distant second (9.7%). For the existing insect spray (label 3), both the Uses (29.6%) and the Do's (36.1%) dominate the first half responses. The dampened role of Use information for insect spray indicates the greater prominence of the hazard warnings for this risky product. The results in these two tables suggest that consumers follow a recall pattern beginning with Uses, or with both Uses and Do's.

*Table 3.* Mean Percentages of First Response and First Two Responses, Classified by Categories of Responses

*Panel A.* Toilet Bowl Cleaner

| | Label # | | | |
|---|---|---|---|---|
| | 1: No Risk Info. | | 2: Risk Info. | |
| Response Category | First | First Two | First | First Two |
| | % | % | % | % |
| Uses | 83.2 | 85.7 | 74.5 | 77.6 |
| Don'ts, Hurts, Do's | 16.8 | 14.1 | 25.5 | 22.4 |
| Don'ts | 1.9 | 1.7 | 3.2 | 4.2 |
| Hurts | 0 | 0.5 | 1.4 | 2.6 |
| Do's | 14.9 | 11.9 | 20.9 | 15.6 |
| Antidotes | 0 | 0.2 | 0 | 0 |
| N | 214 | 410 | 220 | 427 |

*Panel B:* Insect Spray

| | Label # | | | | | |
|---|---|---|---|---|---|---|
| | 1: No Risk Info. | | 2: Risk Info. | | 3: Risk Info. Plus Clutter | |
| Response Category | First | First Two | First | First Two | First | First Two |
| | % | % | % | % | % | % |
| Uses | 46.4 | 55.1 | 36.2 | 37.7 | 24.3 | 28.4 |
| Don'ts, Hurts, Do's | 53.6 | 44.9 | 63.5 | 62.3 | 75.7 | 71.0 |
| Don'ts | 4.2 | 6.1 | 8.4 | 13.2 | 16.9 | 20.4 |
| Hurts | 3.0 | 3.0 | 2.8 | 4.2 | 5.1 | 6.5 |
| Do's | 46.4 | 35.8 | 52.3 | 44.9 | 53.77 | 44.1 |
| Antidotes | 0 | 0 | 0 | 0 | 0 | 0.6 |
| N | 168 | 296 | 178 | 332 | 177 | 324 |

In the second half of the responses for the existing labels, the Uses diminish markedly and the Don'ts increase, but are mixed with Do's. Thus, the role of risk-related responses increases greatly for the second half of the responses. For toilet bowl cleaner the second half responses in table 4 (label 2) show that the Uses fall from 82.7% to 36.6%, while the Don'ts (30.3%) overtake the Do's (20.7%). For the insect spray (label 3) the Uses fall off from 29.6% to 21.1%, and the Don'ts increase from 23.8% to 29.2%, with the Do's declining slightly to 33.6%. Interestingly, the Hurts percentage increases only slightly from the first half responses to the second half responses, an observation that is consistent with their central role as a referral response that will be discussed below.

Table 4 also suggests that Antidotes tend to be recalled in the later stages of the memory recall, if at all. For toilet bowl cleaner label 2, the percentage of Antidotes jumps from 0.6% to 8.5% from the first to second half responses. Similarly, for insect spray label 3 the antidotes jump from 4.2% in the first half responses to 7.1% in the second half responses. These results suggest that after starting with Uses and Do's, consumer recall moves to Do's and Don'ts, which are finally followed by Antidotes, with the Hurts mixed fairly evenly throughout the responses. This is sensible in the case of the Antidotes section since consumers can refer to the label after the adverse outcome has occurred rather than before.

Examining the patterns of transitions from one category of responses to another in tables 5 and 6 provides a second test of the hierarchy of information recall, where by transitions we mean the relationship between the categories of the successive responses given by consumers. Again we focus on the existing products, toilet bowl cleaner label 2 and insect spray label 3. Table 5 displays the recall percentages of each of the five categories of responses, *given* the category of the previous response. For example, for toilet bowl cleaner label 2, 87.5% of the Uses responses were followed by another Uses response. Table 6 normalizes the percentages in these transition matrices by the percentage of each category of *subsequent* response in the total sample, as listed in table 4. This normalization allows us to compare the percentages in table 5 to those which would occur if there were *no relationship* between successive responses. Therefore, numbers greater than one indicate that the chance of the subsequent response occurring is increased. Again using toilet bowl cleaner label 2 as an example, the percentage of Uses responses following other Uses responses (81.1%) is 1.32 times higher than the fraction (61.5%) that would occur if responses were totally independent of each other.

First examine the probabilities of remaining in the same category from one response to another, as shown by the diagonals. Typically, these diagonal elements are the largest elements in the rows, indicating a higher probability of remaining within a cateogry than moving to any other specific category. Most of the diagonals in the unnormalized percentages of table 5 are greater than 50%, indicating quite reasonably that it is more likely for consumers to recall successive responses within the same category than to move out of a category. The normalized percentages in the diagonals of table 6 all exceed 1.00, indicating that the likelihood of remaining in a category is higher than would be predicted by using the overall percentages of responses in each category. Again, this result supports the finding that in recalling information from labels, consumers tend to search within categories of responses rather than searching randomly across all categories.

Two categories deserve special mention, however. The unnormalized Uses responses in table 5 show the highest probabilities of remaining within the category (81.1% for toilet bowl cleaner and 64.9% for insect spray), providing part of the explanation for the high prevalence of Uses responses recalled (see table 4). In contrast, the unnormalized Hurts responses in table 5 indicate that among the five categories, Hurts are least likely to trigger recall of another response in the same

*Table 4.* Means Percentages of Responses Divided into Total, First Half, and Second Half, and Classified by Categories Responses

*Panel A:* Toilet Bowl Cleaner

| | | Label # | | | | |
|---|---|---|---|---|---|---|
| | | No Risk Info. | | | 2: Risk Info. | |
| Response Category | Total | 1st | nd | Total | 1st | 2nd |
| | | % | | % | % | % |
| Uses | 45.3 | 89.7 | 58.3 | 61.5 | 82.7 | 36.6 |
| Don'ts, Hurts, Do's | 23.9 | 10.3 | 39.8 | 34.2 | 16.7 | 54.9 |
| Don'ts | 8.79 | 1.66 | 17.23 | 16.78 | 5.40 | 30.27 |
| Hurts | 2.29 | 0.50 | 4.41 | 2.68 | 1.60 | 3.91 |
| Do's | 12.82 | 8.13 | 18.24 | 14.74 | 9.74 | 20.75 |
| Antidotes | 0.82 | 0 | 1.80 | 4.26 | 0.58 | 8.5 |
| | 1092 | 598 | 494 | 1269 | 685 | 584 |

*Panel B:* Insect Spray

| | | Label # | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | No Risk Info. | | | Risk Info. | | 3: Risk Info. Plus Clutter | | |
| Response Category | otal | 1st | 2nd | Total | | 2nd | Total | 1st | 2nd |
| | % | % | | % | | | | % | |
| Uses | 50.0 | 57.4 | 39.8 | 30.7 | 36.8 | 23.0 | 25.9 | 29.6 | 21.1 |
| Don'ts, Hurts, Do's | 50.0 | 42.6 | 60.2 | 63.7 | 59.8 | 68.7 | 68.6 | 66.2 | 71.7 |
| Don'ts | 13.1 | 8.1 | 20.1 | 22.2 | 19.5 | 25.7 | 26.2 | 23.8 | 29.2 |
| Hurts | 3.0 | 2.4 | | 4.2 | 3.9 | 4.6 | 7.4 | 6.3 | 8.9 |
| Do's | 33.9 | 32.1 | 36.4 | 37.3 | 36.4 | 38.4 | 35.0 | 36.1 | 33.6 |
| Antidotes | 0 | 0 | 0 | 5.6 | 3.5 | 8.4 | 5.5 | 4.2 | 7.1 |
| N | 540 | 371 | 169 | 32 | 462 | 70 | 547 | 432 | 336 |

*Table 5.* Transition Matrices Relating Sequential Responses (%)

*Panel A:* Toilet Bowl Cleaner

1) *Label 1.* No Risk Information

| | Subsequent Response (Given Previous Response) | | | | | |
|---|---|---|---|---|---|---|
| Previous Response | Uses | Don'ts | Hurts | Do's | Antidotes | N |
| Uses | 87.5 | 4.0 | 1.3 | 7.2 | 0 | 718 |
| Don'ts | 6.0 | 58.2 | 6.0 | 26.9 | 3.0 | 67 |
| Hurts | 28.6 | 9.5 | 28.6 | 19.0 | 14.3 | 21 |
| Do's | 20.5 | 26.9 | 7.7 | 42.3 | 2.6 | 78 |
| Antidotes | 0 | 25.0 | 0 | 25.0 | 50.0 | 4 |

2) *Label 2.* Risk Information

| | Subsequent Response (Given Previous Response) | | | | | |
|---|---|---|---|---|---|---|
| Previous Response | Uses | Don'ts | Hurts | Do's | Antidotes | N |
| Uses | 81.1 | 8.0 | 1.5 | 9.1 | 0.3 | 715 |
| Don'ts | 3.7 | 61.9 | 3.1 | 19.4 | 11.9 | 160 |
| Hurts | 19.0 | 19.1 | 28.6 | 33.3 | 0 | 21 |
| Do's | 22.7 | 35.3 | 6.7 | 30.3 | 5.0 | 119 |
| Antidotes | 7.3 | 14.3 | 2.4 | 9.8 | 65.9 | |

*Panel B:* Insect Spray

1) *Label 1.* No Risk Information

| | Subsequent Response (Given Previous Response) | | | | | |
|---|---|---|---|---|---|---|
| Previous Response | Uses | Don'ts | Hurts | Do's | Antidotes | N |
| Uses | 75.0 | 8.6 | 0.4 | 16.0 | 0 | 268 |
| Don'ts | 20.0 | 45.4 | 7.3 | 27.3 | 0 | 55 |
| Hurts | 13.3 | 6.7 | 26.7 | 53.3 | 0 | 15 |
| Do's | 21.2 | 21.2 | 3.0 | 54.6 | 0 | 132 |
| Antidotes | 0 | 0 | 0 | 0 | 0 | 0 |

2) *Label 2:* Risk Information

| | Subsequent Response (Given Previous Response) | | | | | |
|---|---|---|---|---|---|---|
| Previous Response | Uses | Don'ts | Hurts | Do's | Antidotes | N |
| Uses | 64.3 | 10.2 | 3.7 | 20.4 | 1.4 | 216 |
| Do's | 7.1 | 49.0 | 1.9 | 31.0 | 11.0 | 155 |
| Hurts | 25.0 | 12.5 | 41.7 | 12.5 | 8.3 | 24 |
| Don'ts | 14.4 | 27.5 | 4.1 | 51.8 | 2.2 | 222 |
| Antidotes | 5.4 | 21.6 | 0 | 18.9 | 54.1 | 37 |

3) *Label 3:* Risk Information Plus Clutter

| | Subsequent Response (Given Previous Response) | | | | | |
|---|---|---|---|---|---|---|
| Previous Response | Uses | Don'ts | Hurts | Do's | Antidotes | N |
| Uses | 64.9 | 16.7 | 4.8 | 13.1 | 0.6 | 168 |
| Don'ts | 2.6 | 52.2 | 4.5 | 28.0 | 12.7 | 157 |
| Hurts | 18.0 | 12.8 | 33.3 | 35.9 | 0 | 39 |
| Do's | 17.8 | 25.6 | 9.4 | 45.6 | 1.6 | 191 |
| Antidotes | 5.7 | 20.0 | 5.7 | 17.1 | 51.4 | 35 |

*Table 6.* Normalized Transition Matrices Relating Sequential Responses

*Panel A:* Toilet Bowl Cleaner—Label 2

| Initial Response | Subsequent Response (Given Previous Response) | | | | |
|---|---|---|---|---|---|
| | Uses | Don'ts | Hurts | Do's | Antidotes |
| Uses | 1.3* | 0.5 | 0.6 | 0.6 | |
| Don'ts | 0.1 | 3.7 | 1.2 | 1.3 | |
| Hurts | 0.3 | 1.1 | 10.7 | 2.2 | 0 |
| Do's | 0.4 | 2.1 | 2.5 | 2.0 | |
| Antidotes | 0.1 | 0.9 | 0.9 | 0.7 | 15.6 |

*Panel B:* Insect Spray—Label

| Initial Response | Subsequent Response (Given Previous Response) | | | | |
|---|---|---|---|---|---|
| | Uses | Don'ts | Hurts | Do's | Antidotes |
| Uses | 2.5 | 0.6 | 0.6 | 0.4 | 0.1 |
| Don'ts | 0.1 | 2.0 | 0.6 | 0.8 | 2.3 |
| Hurts | 0.7 | 0.5 | 4.5 | 1.0 | 0 |
| Do's | 0.7 | 1.0 | 1.3 | 1.3 | 0.3 |
| Antidotes | 0.2 | 0.8 | 0.8 | 0.5 | 9.4 |

*As an example, figure 1.3 measures the ratio of the percentage of Uses responses that follow directly after a Uses response (81.1% from table 5) divided by the percentage of Uses responses that would occur if all the responses were completely independent (61.5% from table 4).

category (28.6% for toilet bowl cleaner and 33.3% for insect spray), indicating that the Hurts responses cause consumers to remember other related, but nonrisk information. However, the normalized Hurts responses in table 6 show that recalling a Hurts response more than doubles the likelihood of recalling a Hurts responses in the next response. Together, these two results suggest that consumers tend to move from a Hurts response to either another Hurts response or a Do or Don't precaution related to the risk identified by the Hurt response. Thus, in a cognitive sense Hurts are central, appearing to evoke other precautions that prevent the risks associated with the Hurts responses.

The degree to which one category evokes another is evidence of those categories being cognitively associated. For example, table 5 shows that Uses are unlikely to evoke any other category, but when switching categories occurs the Hurts are most often followed by Do's (33.3% for toilet bowl cleaner and 35.9% for insect spray). Once a Do is evoked, however, it strongly evokes Don't responses and other Do's. Don'ts then evoke more Don'ts as well as Do's (19.4% for toilet bowl cleaner and 18.0% for insect spray).

Two conclusions arise from this examination of the sequential patterns of responses. First, when consumers move out of the Uses category to recall other information on the label, they recall predominantly Do and Don't responses, which tend to generate mainly other Don't and Do responses. This switching pattern supports the hierarchical structure of recall presented earlier based on the timing of

the recall. Second, it appears that certain categories are important in eliciting others. Don't and Do responses evoke more of each other, while Hurts elicit both types of precautionary responses. Thus, in recalling the information from labels on hazardous chemicals, consumers tend to first recall Uses, or Uses and Do's, followed by Do's and then by Don'ts, with the Do's and Don'ts evoking each other. Antidotes are more likely to be recalled near the end of the memory recall, with Hurts remembered throughout and playing a triggering role in recalling related Do's and Don'ts.

## 5. Impact of labels on the information recall

Having analyzed the patterns of recall of the information from the labels on the two existing products to learn about how the information from the labels is stored in consumers' memories, we now assess the importance of several key attributes of labels in evoking recall of information.

As described in section 3, the labels were designed to differ in the key attributes outlined in table 1. Thus, comparisons of responses to different labels allow us to draw inferences about the impact on memory recall of those systematic differences across labels.

We will contrast the responses to the labels using two approaches. First, table 7 displays the mean numbers of responses to each of the labels divided into the five response categories, as well as the combined group of the Don'ts, Do's, and Hurts responses. By comparing the mean numbers of responses across labels and consulting the *t*-statistics in table 8, we directly test the effects of the labels upon recall. Regression equations that add demographic and product usage variables to explain the variances across labels are not reported because the main effects of the labels were not found to be affected by the addition of these covariates.[10]

The second approach examines the order of responses to the labels, contrasting the different labels, using the data in tables 3, 4, 5 and 6. While less informative than the mean numbers of responses in table 7, this information provides supporting evidence and helps explain the variations in the mean numbers of responses.

### *5.1. Effects of precautionary information on labels*

The first contrast of responses to labels tests whether the labels provided any new information about risks and precautions to consumers beyond what they already knew from using other products in the same product class. This contrast also reveals what new information they learned from the labels. Toilet bowl cleaner label 1 and insect spray label 1 both contain no risk and precautions information, but in all other respects they are identical to the labels on existing products, that is, toilet bowl cleaner label 2 and insect spray label 3. The precautions recalled from the respondents who were shown labels without any risk and precautions informa-

tion come predominantly from information stored in long-term memory before the experiment, and thus provide a baseline from which the marginal effects of precautions and risk information can be assessed.

As expected, the addition of precautions and risk information increased the recall of the combined Don'ts, Hurts, and Do's group by over 50% for both of the products, differences that were highly statistically significant. The individual Don't, Do, and Hurt category responses all increased for both products, with four of the six differences significant at the 95% confidence level.

For both products the Uses responses declined with the addition of risk and precaution information, although only the insect spray difference was statistically significant at the usual levels. Since the toilet bowl cleaner label had comparatively low informational content in all cases, it is likely that the informational demands on consumers' cognitive capabilities were more in line with their processing abilities. Based on the insect spray results, which should be more meaningful, it appears that adding additional information to a label has a negative impact on one's ability to recall other information on label. This is an important result that suggests there is an opportunity cost to any new item of information placed on a label in terms of the total amount of information recalled. It should be pointed out that in this case the total number of responses increased upon adding the precautions and risk information (see table 6), implying that the reduction in Uses responses is not a direct substitution of non-uses for Uses recall. Thus, the bounds on consumers' cognitive limits are somewhat elastic, a finding that is replicated below in another context.

Examination of the order of responses also provides some insight into the changes in mean responses described above. In table 7 the precautions category with the largest percentage increase in responses was the Don't responses, which more than doubled upon adding the precautions and risk information to the labels. This increase in Don't responses occurred because the hazard warnings led consumers to be more likely to repeat a Don't response, as well as to switch from another category of responses to the Don't category, especially from the central Hurts category. The probability of moving from a Hurts response to a Don't response increased from 9.5% to 19.1% for toilet bowl cleaner and from 6.7% to 12.8% for insect spray (see table 5).

The reduction in Uses responses caused by the addition of risks and precautions information to the labels appears to be caused by three effects: consumers tended to start by recalling fewer Uses responses; they were less likely to repeat a Uses response; and once out of the Uses category they were less likely to return to a Uses responses. The fraction of Uses responses in the first two responses declined from 85.7% to 77.6% for toilet bowl cleaner and from 55.1% to 28.4% for insect spray (see table 3). Moreover, the probability of remaining within the Uses category on successive responses declined from 87.5% to 81.1% for toilet bowl cleaner and from 75.0% to 64.9% for insect spray (see table 5). Finally, once out of the Uses category, the chances of switching to a Uses response declined from 73.6% to 58.7% for toilet

*Table 7.* Mean Numbers of Responses Classified by Response Category and Label (Std. Errors of Means in Parentheses)

*Panel A:* Toilet bowl cleaner

| Response Category | Overall | Label 1: No Risk Info. | Label 2 Risk Info. |
|---|---|---|---|
| Don'ts, Hurts, Do's | 2.04 | 1.21 | 1.99 |
| | (0.06) | (0.10) | (0.11) |
| Don'ts | 0.95 | 0.45 | 0.98 |
| | (0.04) | (0.06) | (0.09) |
| Hurts | 0.21 | 0.12 | 0.16 |
| | (.02) | (0.03) | (0.03) |
| Do's | 0.88 | 0.65 | 0.86 |
| | (0.03) | (0.06) | (0.05) |
| Uses | 3.53 | 3.81 | 3.54 |
| | (.08) | (0.16) | (0.15) |
| Antidotes | 0.18 | 0.04 | 0.24 |
| | (0.02) | (0.02) | (0.06) |
| Total | 5.75 | 5.07 | 5.78 |

*Panel B:* Insect Spray

| Response Category | Overall | Label 1: No Risk Info. | Label 2: Risk Info. | Label 3: Risk Info. Plus Clutter |
|---|---|---|---|---|
| Don'ts, Hurts, Do's | 2.74 | 1.94 | 2.98 | 2.94 |
| | (0.07) | (0.15) | (0.17) | (0.16) |
| Don'ts | 1.04 | 0.53 | 1.06 | 1.14 |
| | (0.05) | (0.07) | (0.11) | (0.11) |
| Hurts | 0.21 | 0.13 | 0.20 | 0.32 |
| | (.02) | (0.04) | (0.04) | (0.05) |
| Do's | 1.49 | 1.28 | 1.73 | 1.48 |
| | (.04) | (0.10) | (0.10) | (0.10) |
| Uses | 1.46 | 1.87 | 1.42 | 1.10 |
| | (0.06) | (0.15) | (0.12) | (0.12) |
| Antidotes | 0.23 | 0.00 | 0.26 | 0.23 |
| | (0.03) | (0.00) | (0.06) | (0.06) |
| Total | 4.43 | 3.81 | 4.67 | 4.27 |

*Table 8.* *t*-Statistics for Differences in Mean Numbers of Responses

*Panel A:* Toilet Bowl Cleaner

| Response Category | Label 2–Label |
|---|---|
| Don'ts, Hurts, Do's | 5.25 |
| Don'ts | 4.94 |
| Hurts | 0.92 |
| Do's | 2.66 |
| Uses | −1.27 |
| Antidotes | 3.45 |

*Panel B:* Insect Spray

| Response Category | Label 2–Label 1 | Label 3–Label | Label 3–Label 2 |
|---|---|---|---|
| Don'ts, Hurts, Do's | 4.55 | 4.57 | −0.19 |
| Don'ts | 4.09 | 4.64 | 0.55 |
| Hurts | 1.19 | 3.09 | 1.88 |
| Do's | 3.23 | 1.50 | −1.86 |
| Uses | 2.36 | −4.14 | −1.86 |
| Antidotes | 4.34 | 4.03 | −.35 |

)owl cleaner and from 51.5% to 26.4% for insect spray (calculated from, but not ;hown in table 5). All of these changes were statistically significant.

### 2 *Effects of clutter*

The second contrast tested the effects of adding additional information to the label .bout how to use the product. Relative to the insect spray label 2, the label 3 differs )nly in the additional usage information relating primarily to the ways the product hould be applied. As is clear from an examination of the labels in figure 3, this iew information makes the label more difficult to read. Indeed, the additional in-)rmation made the regular usage statements so hard to read that the recall of .sage information actually declined by a statistically significant amount (see ables 7 and 8). This manipulation provides an example where information verload results in less information retained by the consumer.

Although the number of responses in the combined category of Do's, Don'ts, nd Hurts did not change significantly, the clutter did cause statistically signifi-ant changes in the recall of Hurts and Do's responses, augmenting the number of Iurts responses and decreasing the number of Do's responses (see tables 7 and 8). 'he Hurts responses tend to be general descriptions of the risks from using the roduct, while the Do's responses are much more specific instructions pertaining ) insect spray and are more difficult to find on the label. This difference between ie nature of the two categories of responses suggests that adding clutter to the

label signals to the consumer that the product is hazardous and triggers the recall of ways it might hurt you, but the more product-specific Do's responses that avoid these problems were made more difficult to read and recall. Once again this illustrates the central role of the Hurts responses.

The process data in tables 3 and 4 help explain the effects of clutter on recall. The reduction in the recall of Uses information occurs primarily in the first half of the responses. The percentage of Uses in the first two responses declined from 37.7% to 28.4% due to clutter (see table 3, panel B, labels 2 and 3) and the percentage of Uses in the first half responses decreased from 36.8% to 29.6% (see table 4, panel B, labels 2 and 3) with both declines being statistically significant. In contrast, the second half responses in table 4 declined minimally from 23.0% to 21.1%. The increase in the Hurts responses occurred in both halves, but the decline in Do's responses was concentrated primarily in the last part of the recall.[11] Given that the information recalled earliest tends to be given the most importance by consumers, these process effects suggest that the reduction in recall of Uses is particularly central to the consumers because the bulk of the reduction occurs early in their recall exercise. In contrast, the decline in recall of Do's information was concentrated at the end of the recall, which suggests that it may be less important to consumers.

We conclude from these findings that designers of product labels should be seriously concerned about the effects on recall of cluttering labels with additional information that, for many consumers, may be of subordinate importance. In our experiment, the addition of more detailed usage information actually caused a decline in the recall of the primary usage information, as well as decreasing the recall of the specific Do's precautionary responses. Cluttered labels can be expected to be less effective where the goal of the label is to convey the same information to all consumers; however, they may be more effective where differing information needs require that different users recall different information from the label.

We caution that our laboratory results only suggest that in real purchase and use situations consumers will retain less information about products when the labels are cluttered with information of subsidiary importance. In some cases the information provided is redundant, and in others it has very little value with respect to likely consumer usage of the product, so the basic message of the label is obscured. Consumers could make up for the reduction in immediate recall of usage information by rereading the labels before using the products, but after purchasing them. Alternatively, while in the store they may choose to spend more time than we allotted them in reading complex labels. Finally, they may overcome the immediate reduction in recall in their initial purchase experience by learning more about usage information through subsequent purchases.

## 6. Conclusions

We have developed and demonstrated a methodology for assessing the impact of different product labels on consumers' recall of the information on the labels. The

unaided recall approach was found to discriminate well among the different labels in the study in terms of consumer recall of information. To the extent that actual behavior in using the products and taking the recommended precautions corresponds to the memory recall from the labels, this approach allows us to test the relative effectiveness of different product labels. We believe that similar methodologies can be designed to assess the effectiveness of other information programs beyond those relying upon product labeling, such as in-plant warning signs, safety training sessions, and public advertising programs.

One of the major advantages of the unaided recall approach is that it allows the researcher to track the order of responses and thereby assess the structure and priority of information in memory. For the two products we studied, this analysis revealed a natural hierarchy of the information recall by consumers—Uses, or Uses and Do's, tend to be recalled first, and then the relative number of Do and Don't responses increases. Hurts play a central role in leading to subsequent recall of the Do's and Don'ts associated with them, and Antidotes tend to be recalled last. The discovery of this hierarchy has important implications for the design of labels to the extent that they can be structured to reinforce this same pattern of recall, rather than compete with it.

Although consumers who are likely to use hazardous chemical products are already familiar with many of their risks and precautions, the addition of risk and precautionary information on the product labels does lead to significantly more knowledge of specific risks and precautions. However, there was a cost of this increase in the retention of risk and precautions information, namely, the decreased ability of consumers to recall the information about product usage.

Adding clutter to the label in the form of additional information about product usage created a complicated set of changes in the types of information recalled by consumers. Individuals responded to the clutter by retaining less of the information on the label, reducing their recall of both the most important information about usage as well as the highly specific Do's precautions. At the same time they did recall more of the risk information (Hurts) on the label, perhaps because the clutter signaled to them that the product was more complicated and therefore more dangerous to use. These reactions to the addition of more usage information to the label indicate that adding more information to product labels does not necessarily lead to the recall of more information, and, therefore, to safer and more informed use of the products. Indeed, our results suggest that adding clutter to a label in the form of less important usage information can cause less recall of the most important information on the label.

Our findings support the view that there is an upper bound on individuals' abilities to process risk information, and suggest that widely used chemical labels exceed consumers' information processing limits. The difficulty is not simply that individuals process only a small number of pieces of information on a product label and then stop. Rather, the types and quantities of information that are recalled may be affected by the amount of information presented, possibly in an adverse manner. These findings add to the mounting evidence that cognitive factors represent more than an intermediate black box that can be safely ignored by

economists concerned with the rationality of risk-taking behavior. The functioning and limitations of these cognitive factors must be better understood to fully assess the nature of market failures and the efficacy of informational remedies.

**Acknowledgments**

The authors received funding for this research from the U.S. Environmental Protection Agency under Cooperative Agreement CR-811057-02-0. We would like to thank Alan Carlin, Ralph Luken, and Albert McGartland for their assistance with the project, and Anne Forrest for her superb assistance in the administration of the survey and the analysis of the data. A preliminary version of this article was presented at the 1987 meetings of the American Economic Association. Baruch Fischhoff and participants in a Duke Center for the Study of Business Regulation seminar provided several useful insights and suggestions.

## Notes

1. See Viscusi, Magat, and Huber (1986) for an example of how reformatting the information on product labels can increase consumer intentions to take precautionary actions. Magat, Payne, and Brucato (1986) provide an example of how reformatting the information provided by home energy audits can improve the effectiveness of consumer energy conservation decisions.

2. See Viscusi and Magat (1987).

3. See section 2 for a further description of the research methodology and the linkage between memory and precautionary behavior.

4. Gabriel Biehall and Dipankar Chakravarti (1982) also use memory recall patterns to infer the organization of consumer memory, while Biehall and Chakravarti (1986) use a free recall task to learn about memory processes in consumer choice.

5. See Russo (1974), Summers (1974), Wilkie (1974), and Staelin and Payne (1976).

6. The analogy to advertising research is quite close. Advertisers regularly test the recall of different versions of their advertisements in order to discover which formats induce the best recall, and thus presumably the largest increase in demand for the products being advertised.

7. Despite efforts to assure interviewer uniformity, some interviewers differed in terms of the number of responses that subjects provided to their interview question. To guard against this source of bias, care was taken to ensure that each interviewer conducted approximately the same number of interviews for each variant of the product labels. This balancing ensures that differences in responses across labels are not due to differences in interviewers.

8. Although not reported here, in Viscusi and Magat (1986) we compare the mail sample characteristics in table 2 to the same characteristics of a telephone survey of toilet bowl cleaner and insect spray users. We found similar mean characteristics, confirming the representativeness of our mall samples.

9. For another example of a study of the structure of memory see Scrull, Lichtenstein, and Rothbart (1985). As in our study, they provide information to subjects and then examine information recall by analyzing the fraction of responses in different categories, the items recalled first, and the order in which the information is recalled.

10. By adding cross-product terms composed of the label dummy variables multiplied by the demographic variables (e.g., income and education), we did test whether the demographic variables caused a differential effect of the labels on the number of responses in each category. However, these equations do not show any significant interactive effect with the label dummy variables.

11. With the uncluttered label 2, 48.6% of the last two responses given by subjects were Do's responses, whereas with the cluttered label 3 that figure fell to 42.8%.

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