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Consumer Product Warnings: The Role of Hazard Perception

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Three studies examined factors associated with people's hazard perceptions of consumer products. A specific interest was how these perceptions relate to willingness to read product warnings. In Study 1, 72 generically-named products were rated on perceived hazard, familiarity, and several expectations associated with warnings, including willingness to read them. Willingness to read warnings was found to have a strong positive relationship with perceived hazard. Though familiarity was negatively related to willingness to read warnings, it provided little predictive value beyond perceived hazard. In addition, products judged as more hazardous were expected to have warnings, to have them in close proximity to the product, and to be less aesthetically impaired by prominent warnings. Since hazard perception was found to be an important determinant of willingness to read warnings, potential components of hazard perception were examined in Studies 2 and 3. Study 2 showed that perceived severity of injury related more strongly to perceptions of hazard than likelihood of injury. In Study 3, participants generated accident scenarios and rated the severity and likelihood of each scenario. For each product, they also judged overall hazard and their intent to behave cautiously. Results supported the two earlier studies and showed that severity of the first generated scenario was most predictive of hazard perception. Theoretical implications and applications for warning design are discussed.

Recent years have witnessed increasing interest in the efficacy of product warnings. McCarthy, Robinson, Finnegan, and Taylor (1982) pointed out that virtually no scientific evidence existed at that time to demonstrate improved product safety as a result of on-product warnings. Partly as a result of the McCarthy et al. (1982) analysis, as well as the increasing attention to warning issues in product liability litigation, a body of scientific literature has developed addressing product warning effectiveness. However, as DeJoy (1989) noted in a recent review, there are still surprisingly few studies that have empirically examined the issues. The studies reported here represent an attempt to contribute to the scien-

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tific literature and to our understanding of product warning effectiveness.

Despite efforts to present effective warnings on products, it is apparent that information conveyed by warnings may fail to reach consumers (Wogalter, Godfrey, Fontenelle, Desaulniers, Rothstein, & Laughery, 1987). Three reasons for the communication failure can be offered: (a) Consumers simply may not see the warning. A warning located after a set of procedural instructions may be unnoticed because people quit reading the label before seeing the warning (Wogalter et al., 1987); (b) Consumers might not understand the warning. The reading level may be too difficult for the target audience (e.g., Morris, Meyers, & Thillman, 1980; Pryczak & Roth, 1976); and (c) Consumers may ignore the warning even when it is visible and comprehensible.

Why might consumers not be willing to read a product warning? One possible reason is that people do not read warnings on products that they perceive to be safe or familiar. Godfrey, Allender, Laughery, and Smith (1983) found that participants reported they would be more likely to look for and read warnings on products judged to be more hazardous and less familiar. Similar results were found by LaRue and Cohen (1987) using a diverse sample of consumers at an outdoor flea market (swap meet).

However, Wright, Creighton, and Threfall (1982) did not find a relationship between reading product instructions and judgments of safety or familiarity. This discrepancy may be due to procedural differences. While Godfrey et al. (1983) and LaRue and Cohen (1987) asked participants whether they would look for and/or read warnings, Wright, Creighton, and Threlfall asked whether they would read instructions. These studies also differed in the number of products employed. Godfrey et al. used eight products, LaRue and Cohen used 12 products, and Wright et al. used 60 products. Since it is not clear what effects these differences had, further investigation of willingness to read product warnings seems warranted.

Study 1 examined whether hazard perception and familiarity are related to willingness to read warnings for 72 consumer products. This study also explored several expectations or opinions that people may have concerning product warnings. Specifically, information was obtained about the necessity of warnings, where warnings should be located and whether or not the warnings detracted from the appearance of products. These opinions or expectations may have implications for warning communication effectiveness.

Study 2 investigated the contribution of three factors to hazard perception: (a) perceived severity of injury, (b) perceived likelihood of injury, and (c) product knowledge. It has been proposed that people's judgments of risk combine both severity and likelihood information (e.g., Lowrance, 1980; Slovic, Fischhoff, & Lichtenstein, 1979). Study 2 examined whether severity and likelihood of injury predict people's perception of hazard. In addition, several product knowledge measures were examined to determine their usefulness in predicting hazard perception.

Study 3 employed a different approach to investigate perceived hazard, using severity and likelihood ratings of accident scenarios generated by participants. Fischhoff, Slovic, and Lichtenstein (1978) and Brems (1986) showed that people often fail to recall and consider failure modes that they already know. This study examined the characteristics of the accident scenarios that people do recall and whether these characteristics relate to judgments of hazard. Study 3 also addressed whether hazard perception is a useful predictor of precautionary intentions.

STUDY 1

Study 1 examined whether hazard perception and familiarity relate to willingness to read warnings. In addition, this study explores three expectations that people might have concerning consumer product warnings: (a) judged necessity for warnings, (b) expected location of warnings, and (c) whether warnings detract from the appearance of products.

Method

Participants. One hundred twenty five Rice University undergraduates participated; they were run in groups of 5 to 20 and were given course credit. At a later time, a second group of 20 students participated in a replication of the hazard ratings.

Materials. A large sample of consumer products were selected from several major department store catalogs (e.g., Best Products, JC Penny, Montgomery Ward). These products were combined with examples of common food products and over-the-counter pharmacy items. The resulting sample consisted of 72 products (1) that could be found in U.S. households, (2) that represented a wide range of hazards, and (3) that consisted of three broad product categories: (a) electrical, (b) chemical, and (c) nonelectrical tools. Only generic names of products were used as stimuli. Table 1 shows the list of products grouped by category.

Products were rated on several dimensions. For each product, participants responded to six questions on Likert-type scales. The questions and the numerical and verbal anchors were:

TABLE 1
PRODUCTS IN STUDIES 1 AND 2
GROUPED BY CATEGORY

Electrical	
battery alarm clock	microwave oven
curling iron	photoflash unit
desk lamp	pocket calculator
digital watch	quartz space heater
drip coffee maker	sewing machine
electric blanket	sunlamp
electric carving knife	steam iron
electric food slicer	toaster-oven
electric hedge trimmer	transistor radio
electric typewriter	trash compactor
flashlight	oscillating fan
metal detector	vacuum cleaner
Chemical	
antacid	kerosene
apple sauce	lacquer stripper
artificial sweetener	milk
aspirin	nonprescription diet aid
baby powder	oven cleaner
cake mix	roasted peanuts
cough medicine	roll-on deodorant
drain cleaner	shampoo
dried cereal	skin moisturizer
eggs	soap
household bleach	suntan lotion
insecticide/pesticide	whiskey
Non-electrical Tools	
binoculars	hunting knife
chain saw	inflatable boat
clothesline	ladder
dart game	life vest
football helmet	ping pong table
garden shears	rake
garden sprinkler	screwdriver
gas outdoor grill	scuba gear
gas powered lawn mower	semi-automatic rifle
golf club	three-speed bicycle
hammer	wheel barrow
hiking boot	wood splitter

(1) "If you saw a warning on this product would you read it?" anchored by (1) definitely no, (2) probably no, (3) possibly no, (4) possibly yes, (5) probably yes, and (6) definitely yes.

(2) "How hazardous is the product?" anchored by (1) not at all, (2) a little, (3) some, (4) moderately, (5) fairly, (6) very, and (7) extremely.

(3) "How familiar is the product?" anchored by (1) not at all, (2) a little, (3) some, (4) moderately, (5) fairly, (6) very, and (7) extremely.

(4) "Do you think there should be a warning on this product?" anchored by (1) definitely no, (2) probably no, (3) possibly no, (4) possibly yes, (5) probably yes, and (6) definitely yes.

(5) "Where would you most expect to find a warning on this product?" Several alternative choices were provided: on the product, on the package, at the beginning of an instruction booklet, at the end of an instruction booklet, on a piece of paper separate from the instructions, and the last alternative was "I would not expect a warning on this product." These alternatives were assumed to reflect a distance metric indicating expected proximity between the product and a warning. These alternatives were subsequently coded from 1 to 6 with lower numbers indicating a shorter warning-to-product distance.

(6) "Do you think a warning that is visible when the product is in use would make the product less attractive?" anchored by (1) definitely no, (2) probably no, (3) possibly no, (4) possibly yes, (5) probably yes, and (6) definitely yes.

All participants rated the 72 products on all six questions. The product names were listed along the left column of two rating sheets. To the right of the product names were six columns of blank spaces where participants recorded their ratings.

Procedure. Participants were given one of four random orders of product names. They were told to read over the list to familiarize themselves with the type and variety of products shown. Two minutes were provided for this familiarization. They were then given a sheet with the set of questions. It was emphasized that they should rate all products on Question 1 before proceeding to Question 2, and so on. Participants were told to assume that the generically-named products were from a new manufacturer or had a new brand name. A second group of 20 participants rated the same set of products on the hazard question for the purpose of obtaining a measure of reliability.

Results

Individual participant ratings were collapsed into mean scores for each of the 72 products and these means were used in the analyses. The intercorrelations between product ratings are shown in Table 2.

Initial analyses focused on factors related to willingness to read warnings. Participants were more likely to read warnings on products perceived to be more hazardous, r (70) = .89, $p < .0001$, and less familiar, r (70) = –.64, $p < .0001$. More hazardous products tended to be less familiar, r (70) = –.63, $p < .0001$.

Regression analysis was used to predict willingness to read warnings using perceived hazard and familiarity as predictors. The analysis yielded an R^2 of .81 ($p < .0001$). By itself, perceived hazard accounted for 80% of the variance of willingness to read. Familiarity contributed an unimportant increment in predictiveness — less than 1.0% (p = .07). The relative contribution of an interaction term comprised of the two predictors was also examined. It did not contribute to the prediction of willingness to read over and above perceived hazard ($p > .30$).

Other results showed that willingness to read warnings was strongly related to beliefs that warnings are necessary, r (70) = .94, $p < .0001$, to expectations that warnings should be located closer to the product, r (70) = –.89, $p < .0001$, and to the belief that warnings detract less from the appearance of the product, r (70) = –.45, $p < .0001$. As expected and as shown in Table 2, perceived hazard also shares considerable variance with these three variables.

Ratings from a second group of participants were used to examine the reliability of the first group's hazard ratings. Substantial reliability was found, r (70) = .95, $p < .0001$.

Discussion

The results show that perceived hazard and willingness to read warnings are strongly associated. People reported that they would more likely read warnings on products that they perceived more hazardous. Product familiarity was also significantly related to reading warnings, but it provided little predictive power beyond perceptions of hazard. The results support Godfrey et al. (1983) and LaRue and Cohen (1987) who found that perceived hazard and familiarity were related to the likelihood of looking for and reading warnings. However, the present results extend this earlier work by showing that perception of hazard is more important than familiarity. The results appear inconsistent with the Wright et al. (1982) finding of no relationship between willingness to read instructions and safety. However, since Wright et al. found that participants were willing to read instructions for more complex products than for simpler ones, it seems likely that in their study, participants were considering the products' operational instructions rather than safety directives like warnings.

The results contained several other interesting relationships: (a) people expect hazardous

TABLE 2
INTERCORRELATIONS OF MEAN PRODUCT RATINGS AMONG QUESTIONS IN STUDY 1

	Willing to read warning	Product hazard	Product familiarity	Necessity of warning	Location of warning
Product hazard	.89				
Product familiarity	-.64	-.63			
Necessity of warning	.94	.95	-.62		
Location of warning	-.88	-.81	.49	-.92	
Less attractive	-.45	-.54	.35	-.51	.50

Note. n = 72 products. All rs have ps < .001.

products to have warnings; (b) they expect hazardous products to have warnings located in close proximity; and (c) they believe that warnings do not detract from the appearance of hazardous products. These results have implications for manufacturers. First, people may use the presence of a warning as a cue to help them determine whether a product is hazardous or not. If a warning is not apparent, people may assume that the product is less hazardous than it actually is, which could lead to less precaution and possible injury. Second, warnings should be located in close proximity because this is where people expect them to be. If a warning is not located on or near the product people may not see it and incorrectly assume that there is no hazard. Third, the results suggest that manufacturers of hazardous products do not need to be overly concerned about diminished attractiveness of their products due to warnings. Fortunately, people judge safety to be more important than aesthetics. Related to this is the notion that warnings adversely affect people's willingness to purchase products. This assumption, however, was not supported in two recent studies (Laughery & Stanush, 1989; Silver, Leonard, Ponsi, & Wogalter, in press). Both studies showed no consistent relationship between purchasing intentions and the presence of warnings on hazardous products. Instead, it appears that in some circumstances the presence of warnings might have a positive influence on people's perceptions. For example, Ursic (1984) found that the presence of a warning increased judgments of product effectiveness and safety compared to the absence of a warning. Thus, possible fears by manufacturers that warnings have negative effects (e.g., impaired appearance and lowered sales) may be unfounded when compared to possible positive effects (e.g., good impressions that the manufacturer is concerned for consumer safety and lowered legal liability).

STUDY 2

Study 1 showed that people are more likely to look for warnings on more hazardous products. The next question asked was: What information is involved in the formation of people's perception of hazard? There are several possible sources of information that people might use to form such perceptions. For example, it is reasonable to assume that products that potentially inflict severe injuries or death are judged more hazardous than those capable of inflicting only minor injuries or discomfort.

Another possible component of hazardousness is the likelihood or probability of being injured by the product. Lowrence (1980) and Slovic, Fischhoff, and Lichtenstein (1979) suggest that a related concept, perception of risk, is determined by some combination of both accident severity and likelihood. In Study 2, severity and likelihood of injury were used as predictors of hazard perception. In addition, several combinational models of these two factors were explored to determine best fit.

Another potential component of hazard perception is product knowledge. While judgment of overall familiarity was not found to be a significant contributor in Study 1, the requested impressions might have been too general. More specific product experience and knowledge might contribute to perceptions of hazard. In Study 2, familiarity and several other knowledge-related variables were assessed (frequency of use, duration of contact, technological complexity, and confidence in knowing the hazards).

Method

Participants. Twenty-eight University of Richmond undergraduates participated for extra credit in introductory psychology courses.

Materials and procedure. The products were the same as used in Study 1. The procedure was also identical except a different set of questions was used and each participant received a unique random ordering of the questions. Participants responded to eight questions on nine-point Likert-type scales ranging from zero to eight. The questions and the numerical and verbal anchors are shown below:

(1) "How hazardous is this product?" anchored by (0) not at all hazardous, (2) slightly hazardous, (4) hazardous, (6) very hazardous, and (8) extremely hazardous.

(2) "How severely might you be injured

with this product?" anchored by (0) not severe, (2) slightly severe, (4) severe, (6) very severe, and (8) extremely severe.

(3) "How likely are you to be injured by this product?" anchored by (0) never, (2) unlikely, (4) likely, (6) very likely, and (8) extremely likely.

(4) "How frequently do you use this product?" anchored by (0) never, (2) infrequent, (4) frequent, (6) very frequent, and (8) extremely frequent.

(5) "How much time do you spend with this product each time you use it?" anchored by (0) never, (2) short time, (4) medium time, (6) long time, and (8) very long time.

(6) "How familiar are you with this product?" anchored by (0) not at all familiar, (2) slightly familiar, (4) familiar, (6) very familiar, and (8) extremely familiar.

(7) "Do you consider this product technologically complex?" anchored by (0) not at all complex, (2) slightly complex, (4) complex, (6) very complex, and (8) extremely complex.

(8) "How confident do you feel you are in knowing all the hazards related to this product?" anchored by (0) not at all confident, (2) slightly confident, (4) confident, (6) very confident, and (8) extremely confident.

Results

The correlation matrix is shown in Table 3. The first question addressed was whether severity and likelihood of injury were related to perceptions of product hazard. The simple correlation of hazard perception and severity of injury is positive and large, accounting for 79% of the common variance, r (70) = .89, $p <$ .0001. The correlation of hazard perception and likelihood of injury is also positive, but smaller, accounting for 57% of the common variance, r (70) = .75, $p <$ .0001. The difference between these two correlations is significant, t (69) = 3.90, $p < .01$.

Do people combine their perceptions of severity and likelihood when making judgments of hazard? Several multiple regression models involving severity and likelihood of injury as predictors of hazard were examined. The first analysis employed a linear multiple regression model involving severity and likelihood as additive predictors. The result produced an $R^2 = .792$, which is nearly identical to the proportion of variance accounted for when only severity is used as the predictor (r^2 = .787). The increment due to likelihood was not significant ($p > .30$). A second model involved a multiplicative regression where the predictor was the product of severity and likelihood. This analysis produced an R^2 of .67, which is smaller than the variance accounted by severity alone. A third model involved the variables severity, likelihood, and their interaction as predictors in a linear multiple regression on hazard. This analysis generated an R^2 of .83. The increment in variance accounted by this model compared to the model with only severity as the predictor is very small (.04) but significant ($p < .05$).

The relationships between perceived hazard and several knowledge variables were examined. Perception of hazard was negatively related to familiarity, r (70) = –.36, $p <$ .01; frequency of contact, r (70) = –.27, $p <$ .05; confidence in knowing all of the hazards, r (70) = –.40, $p <$ .001; and positively related to technological complexity, r (70) = .35, $p < .01$. Time of contact was not related to perceived hazard, r (70) = –.15, $p > .05$.

Multiple regression analysis was used to

TABLE 3
INTERCORRELATIONS OF MEAN PRODUCT RATINGS AMONG QUESTIONS IN STUDY 2

	Product hazard	Severity of injury	Likelihood of injury	Frequency of use	Time of contact	Product familiarity	Complexity
Severity of Injury	.89***						
Likelihood of injury	.75***	.80***					
Frequency of use	-.27*	-.38***	-.29*				
Time of contact	-.15	-.25*	-.09	.41***			
Familiarity	-.36**	-.35**	-.31**	.66***	.28*		
Complexity	.35**	.22	.15	-.17	.03	-.41***	
Confidence	-.40***	-.30*	-.15	.28*	.40***	.41***	-.26*

Note. n = 72 products. *$p < .05$. **$p < .01$. ***$p < .001$

examine the relative contribution of the knowledge variables to the prediction of hazard perception (as compared to that accounted for by severity, likelihood, and their crossproduct). Analyses indicated no additional predictiveness from familiarity, frequency of contact, and time of contact. Technological complexity and confidence in knowing the hazards contributed small, but reliable, additional variance to the prediction of hazard perception, 2% and 3%, respectively ($ps < .05$). Simultaneously adding both variables into the prediction equation added 4% ($p < .05$).

Discussion

These results show that severity of injury is the principal predictor of hazard perception. Although the simple correlation between hazard perception and likelihood was significant, regression analyses indicated that the addition of likelihood to a model already containing severity did not enhance the prediction of hazard perception. The further addition of the severity x likelihood crossproduct produced a statistically significant but small (4%) increment in prediction. Despite the fact that this difference is statistically significant, the importance of the contributions of the additional terms is questionable. Severity seems to be the only important predictor of product hazard perception.

The meager contribution of likelihood to hazard perception does not give strong support for Lowrance's (1980) and Slovic et al.'s (1979) formulations that risk perception is determined by a combination of severity and likelihood of accidents. Three possible reasons can be offered.

First, the terms risk and hazard may have different connotations to people. Indeed, there is considerable variation in the definition of risk in the scientific literature. Oppe (1988) points out that risk is sometimes defined statistically in terms of frequency or probability (objective risk), and sometimes risk is used as a synonym for danger or threat (subjective risk).

Second, different methodologies were used. Slovic et al. (1979, 1980) asked participants to estimate mortality rates or make comparative judgments of accident frequencies. This kind of judgment demands consideration of likelihood which might be the reason why they found a contribution of this factor and the present results did not.

Third, the discrepancy might be due to employment of different sets of causative agents. Slovic et al. (1979, 1980) used a stimulus set that included natural disasters such as floods and tornadoes, which might be perceived differently than consumer products. People may consider disasters less controllable than accidents with consumer products (Slovic et al. 1979, 1980). Nevertheless, Slovic et al. (1979, 1980) did find mortality rates were overestimated for agents capable of producing severe consequences, indicating a contribution of severity even for judgments concerned strictly with frequency of events.

In general, familiar products were judged less hazardous, which supports the findings of Godfrey et al. (1983), LaRue and Cohen (1987), and Study 1. This relation may be due to the fact that we tend to restrict our environment to avoid contact with highly hazardous products. However, the results also showed that familiarity does not add much beyond severity to the prediction of hazard perception. Similarly, Study 1 failed to find a significant contribution of familiarity to the prediction of willingness to read warnings after hazard perception was considered.

The other knowledge variables were significantly related to hazard perception (except time of contact), but only two contributed to hazard perception beyond severity: technological complexity and confidence in knowing the hazards. These two variables involve unknown or hidden dangers rather than mere use or exposure. For example, people might regularly use microwave ovens and insecticides, but they are also aware that they do not know all of the potential hazards of these products. This conclusion concurs with Fischhoff, Slovic, Lichtenstein, Read, and Combs (1978) who found that people give greater risk estimates to more technologically-complex accident sources.

The positive correlation observed between severity of injury and likelihood of injury was unexpected. For many situations, one might reasonably assume that these two variables would be negatively related. That is, severe or major injuries are likely to be less common than less severe or minor injuries. It is possible that participants were considering the likelihood of receiving a major injury when making their ratings. This hypothesis was addressed in a subsequent study.

Seventy undergraduates received a set of 18 consumer products and made judgments of hazard, likelihood of causing a major/severe accident, and likelihood of causing a minor accident (injuries not requiring professional medical care). Likelihood of major/severe accidents was found to be positively related to perceptions of hazard, r (16) = .74, $p < .0001$ — a result similar to that obtained in Study 2 ($r = .75$). In contrast, likelihood of minor accidents was not related to perceptions of product hazard, r (16) = –.03, $p > .05$). This outcome suggests that participants in Study 2, when asked to rate the likelihood of being injured by a product, were assuming a major/severe injury.

STUDY 3

Study 3 had three purposes. The first was to determine whether the hazard-severity relationship would be found using a different methodology. In Studies 1 and 2, participants made abstract judgments of products. Participants in Study 3 generated product-related accident scenarios and then evaluated the scenarios with regard to their severity and likelihood of injury. The objective was to determine whether perceptions of scenario severity and likelihood predict judgments of overall product hazard.

The second purpose was to investigate characteristics of scenarios with regard to production order. Previous research indicates that frequency estimates of product-related accidents can be made quickly and do not improve with additional analysis (Brems, 1986; Martin & Wogalter, 1989). These findings suggest that people access hazard knowledge easily. Study 3 examines whether the severity perceptions of the first generated scenario can account for people's hazard perceptions, and whether subsequent scenarios have less utility in this regard.

The third purpose was to further pursue a result found in Study 1, which showed that people are more willing to read warnings on hazardous products. Reading warnings is one of many modes of precautionary behavior. Other modes include wearing protective equipment, preventing child access, and handling the product more deliberately. Since many kinds of precautionary behavior depend on the particular product, a general question on precaution was asked. Of particular interest was whether hazard perception predicts general cautious intent. Given the outcome of Study 1, a strong positive relationship was expected.

Method

Participants. Seventy Rice University and University of Houston undergraduates participated for extra credit in introductory psychology courses.

Materials. The 18 products used in this study are listed in Table 4. These products were selected to represent a broad range of hazards with regard to both severity and likelihood of potential accidents. A random order of the products was arranged on response sheets with spaces for participants' scenario descriptions and ratings. The materials also included instructions, questions, and rating scales.

Procedure. Participants were given a copy of the response sheet and asked to read over the list of products. They were then asked to perform the following five tasks.

The instructions for the first task asked participants to assume that it was necessary for them to use each product. They were asked to "Rate the degree of precautions you would take when using each product." Precaution

TABLE 4
PRODUCTS IN STUDY 3

aerosol insecticide/pesticide	gas-powered lawn mower
aluminum extension ladder	liquid lacquer stripper
antacid	metal detector
apple sauce	outdoor gas grill
bathtub/shower	semi-automatic rifle
capsule diet aid	shampoo
chain saw	steam iron
drip coffee maker	three-speed bicycle
electric hedge	trimmer toaster oven

was explicitly defined as "actions to ensure safety." A 5-point rating scale was provided with the numerical and verbal anchors: (1) use with no precautions, (2) use with minor precautions, (3) use with moderate precautions, (4) use with substantial precautions, and (5) use with extreme precautions.

Second, participants were asked to "Imagine using each product" and then asked "What accidents would you fear occurring?" Participants were told to write down the first three accident scenarios that came to mind in the order that they came to mind. The instructions requested participants to include a description of how each accident occurred and the resulting injury.

Third, participants were asked to "Rate the severity of each injury" that they reported in the scenario generation task on a 7-point scale: (1) no injury, (2) minor injury (remedied by first aid), (3) requires outpatient treatment, (4) short-term disability (under two weeks), (5) long-term disability, (6) permanent disability, and (7) death.

Fourth, participants were asked "How likely would it be, during your next use of the product, that you would experience the kinds of accidents and injuries that you reported" in the scenario generation task. The scale consisted of 8-points: (1) extremely remote, (2) highly remote, (3) remote, (4) unlikely, (5) possible, (6) probable, (7) highly probable, and (8) almost certain.

Fifth, participants were asked to rate the products on overall hazard, specifically asking "How hazardous do you feel each product is?" They responded on a 7-point scale: (1) not at all, (2) a little, (3) some, (4) moderately, (5) fairly, (6) very, and (7) extremely.

Results

A total of 3,760 observations (70 participants × 18 products × 3 scenarios) were possible. In spite of the instructions directing participants to report three accident scenarios for every product, many were unable to generate or failed to report that number. Missing scenarios also lacked ratings. Three percent of the first scenarios were missing. For the second and third scenarios, the number of missing values increased to 25% and 54%, respectively.

The data were aggregated in two ways. One set of analyses used product means averaged across participants as in Studies 1 and 2. The second set of analyses used nonaveraged data involving the raw responses from all participants and all products.

The correlation matrix using product means is shown in Table 5. The correlation between overall product hazard and severity of the first scenario was large and significant, $r\,(16) = .90$, $p < .0001$. The correlations between hazard and the severity of the second and third scenarios were somewhat lower, $r\,(16) = .82$, $p < .0001$, and $r\,(16) = .72$, $p < .0001$, respectively. The correlations between product hazard and the likelihood ratings for the first and second scenarios were not significant ($ps > .05$). However, hazard and injury likelihood of the third scenario yielded a positive correlation, $r\,(16) = .67$, $p < .01$.

Correlations between various scenario ratings and perceived hazard showed that first scenario severity was the best single predictor of judged hazard ($r^2 = .81$). Using the severity ratings of the first scenario as a starting point, several models of hazard pre-

TABLE 5
INTERCORRELATIONS OF MEAN PRODUCT RATINGS AMONG QUESTIONS IN STUDY 3

	Product	First Scenario		Second Scenario		Third Scenario	
	Hazard	Severity	Likelihood	Severity	Likelihood	Severity	Likelihood
Severity 1	.90***						
Likelihood 1	.03	-.18					
Severity 2	.82***	.91***	-.12				
Likelihood 2	.14	-.11	.88***	-.21			
Severity 3	.72***	.81***	-.08	.92***	-.19		
Likelihood 3	.67**	.46	.50*	.38	.62**	.27	
Precaution	.98***	.89***	.02	.77***	.15	.68**	.64**

Note. n = 18 products. *$p < .05$. **$p < .01$. ***$p < .001$.

diction were examined in an effort to increase the proportion of variance accounted for. Neither the addition of the first scenario's likelihood nor the further addition of the cross-product term (comprised of severity and likelihood) significantly enhanced prediction. Moreover, the severity and/or likelihood of the second and third scenarios failed to significantly increase the proportion of variance accounted for by the first scenario's severity (*ps* $> .05$).

The second set of analyses used the nonaveraged raw data, i.e., all participants and products. The pattern of correlations between the hazard ratings and the severity ratings of the three scenarios was similar but smaller than the product means, yet remained reliable, $r\,(1219) = .51, p < .0001$; $r\,(943) = .38, p < .0001$; $r\,(578) = .33, p < .0001$. The relation of hazard with the three scenario likelihood ratings were small but significant, $r\,(1219) = .06, p < .04$; $r\,(943) = .08, p < .05$; $r\,(578) = .14, p < .001$.

Like the product mean analyses, the nonaveraged raw data were used to test several hazard prediction models in an effort to increase the proportion of variance accounted for by the first scenario's severity ratings. The addition of the first scenario's likelihood ratings produced a small, but reliable, increase in hazard prediction (from $r^2 = .26$ to $R^2 = .28$, $p < .05$). Models incorporating the severity ratings of the first two and all three scenarios also significantly improved the prediction of hazard (to $R^2 = .27$, and to $R^2 = .30$, respectively). The further addition of the likelihood ratings (as well as polynomial and crossproduct terms) did not enhance hazard prediction.

The relationship between hazard and precautionary intent was also examined. Using product means, the correlation was extremely high, $r\,(16) = .98$, $p < .0001$. A strong positive relationship was also seen using the nonaveraged data, $r\,(1250) = .79$, $p < .001$. With the large amount of variance in common, it would be expected that precautionary intent would have predictive models similar to hazard perception. Regression analyses using severity and likelihood ratings as predictors of precautionary intent produced outcomes virtually identical to the prediction of hazard perception.

Discussion

The results of Study 3 show that the severity of the first scenario was strongly associated with the products' perceived level of hazard. This result was found consistently across several different analyses using product means, as well as the nonaveraged raw data. The analyses also showed that likelihood of injury did not play an important role in hazard perceptions. Although more complex regression models accounted for additional variance beyond the first scenario's severity, the increments were small and probably not important.

The results also show that precautionary intent is highly related to perceived hazard. This finding extends the willingness-to-read warnings and perceived hazard relation found in Study 1, because a broader range of intentions was assessed by the precautionary question. Apparently, hazard perception and the closely-linked injury severity factor serve as cues in people's judgments of whether to engage in precautionary behavior.

The results also showed that the perceived severity of the first scenario was the single best predictor of hazard perception. In general, information provided by subsequent scenarios provided no additional, useful cues for the judgment of hazard. This result is in accord with the predictions of the availability heuristic (Tversky & Kahneman, 1973; Kahneman & Tversky, 1982) and concurs with Brems (1986) and Martin and Wogalter (1989) who found that accident judgments are made quickly and are not improved with further analytical processing. Together these results suggest that the information that initially comes to mind provides the basis for hazard judgments.

GENERAL DISCUSSION

The present research began with an interest in determining the factors that predict whether warnings would be read. The results of Study 1 showed that the primary determinant of the likelihood of reading warnings is the product's perceived level of hazard. Study 1 also showed that people believe that hazardous products need warnings, expect them to be located in close proximity to the products, and believe that warnings do not detract from their appearance. In the discussion of Study 1, these expectations were noted as having implications for warning communications. For example, people might mistakenly assume that a product is less hazardous than it really is because a warning is not apparent. It was further suggested that the advantages of placing prominent warnings on hazardous products outweigh the disadvantages. Study 1 led to the investigation aimed at identifying determinants of perceived hazard.

In Study 2, three potential components of hazard assessment were examined: (a) the severity of the accident consequences, (b) the perceived likelihood of an accident occurring with the product, and (c) product knowledge. The results revealed that people's judgments of product hazard were closely related to injury severity.

Study 3 extended this finding by revealing that hazard perception is closely related to the severity of the first accident scenario that comes to mind, and that the severity of subsequent scenarios does not appear to further influence perceptions of hazard. These data suggest that judgments of hazard tend to be based on the first information recalled rather than an analysis of alternative outcomes.

The relationship of hazard and first scenario severity suggests that perceptions of hazard will be influenced and potentially biased by any factor that determines which scenario comes to mind first. Biases or inaccuracies in hazard judgments will occur if the most readily imaginable scenario is not representative of how severely one is likely to be injured. For example, the fact that car batteries produce electricity makes the hazard of a painful electrical shock particularly salient; nevertheless, one should not overlook the severe consequences of a chemical explosion when judging the product's hazard level.

Although Studies 2 and 3 revealed that the likelihood of an accident was related to perceptions of hazard, further analyses indicated that judged likelihood of accidents had a negligible influence on hazard level assessments. Though likelihood of a failure is an important consideration in a objective risk analysis, this series of studies does not support the notion that injury likelihood is incorporated into people's subjective judgments of product hazards.

One reason people may not consider accident likelihood when judging product hazards is the extremely low likelihood of most accidents. Although consumers may be capable of making distinctions between Product A and Product B based upon the frequency of injury (Brems, 1986), the distinction between one injury per 10,000 uses versus one injury per 10,000,000 uses is probably meaningless in practical judgments of hazard. Both may be "functionally zero." Consequently, the overriding criterion becomes severity of consequences. Peoples lives are finite and are not amenable to the infinite number of trials which make meaningful such small likelihoods as those associated with consumer product accidents. Capturing this notion are the expressions used by parents to warn their children of the seriousness of certain consequences despite apparently low likelihoods: "It only takes one time . . . " or "It only has to happen once."

In addition to examining the relative contributions of accident severity and likelihood to judgments of product hazard, this research also examined several other measures related to product knowledge (e.g., familiarity), which were expected to influence such judgments. Despite significant correlations with perceived hazard, the product knowledge measures were of little value in predicting hazard beyond that predicted by severity. The exceptions were the variables, technological complexity, and confidence in knowing all of the product's hazards. Both seem to reflect an awareness by participants that hidden or unknown dangers may exist, suggesting that people will read warnings and act with precaution when they are unsure about the hazards.

Some caution is necessary when interpreting the findings of the present studies, particularly with regard to the correspondence between questionnaire and real world responses. In the present study, perceptions and intentions were measured, not actual behavior with products. Nevertheless, recent experimental research provides support for the current findings. Research by Donner (1990) indicates that hazard perception is predictive of warning compliance behavior. In Donner's experiment, warnings on products rated as more hazardous were complied to more often than warnings on products rated as less hazardous. In addition, recent work by Wogalter and Barlow (1990) indicates that warnings are complied to more often when they convey more serious consequences than less serious consequences. However, there was no effect of high versus low likelihood information on compliance. Together, these experimental results suggest that the current findings have some degree of predictive validity, which makes them useful in preliminary decision making with respect to real world safety.

Collectively, the results of these three studies provide insight into the possible mechanisms determining our perceptions of product hazard. Increased knowledge of consumers' hazard judgments can enable better predictions about consumers' intentions to take appropriate precautionary actions. The results also provide insight that might be useful in warning communications. When a product is perceived to be less hazardous than it really is, people may act with less precaution than is warranted. A possible solution is to provide a highly conspicuous warning that emphasizes how severely a person can get hurt to encourage compliance.

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