CONSUMER PRODUCTS: HOW ARE THE HAZARDS PERCEIVED?

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ABSTRACT

Two questionnaire studies were conducted examining potential components of perceptions of consumer product hazardousness. In Study 1 subjects rated 72 consumer products on perceived hazardousness, expected severity of injuries, and perceived likelihood of injury. The results indicate that severity relates more strongly than injury likelihood with perceived hazardousness. Several product knowledge variables were also examined; these results indicate that technological complexity and confidence in knowing the product's hazards add unique variance beyond severity in the prediction of hazard perception. In Study 2 subjects generated accident scenarios for each of 18 consumer products. Subjects rated each scenario according to the severity of the accident and the probability of its occurrence and also provided ratings of overall product hazardousness. Results supported the findings of Study 1. The severity of product injury scenarios were strongly and positively correlated with hazardousness. Probability of injury ratings added negligible hazard predictiveness beyond severity. Product hazardousness was highly correlated with the level of precaution subjects would reportedly take when using the product. For high hazard products the first scenario generated was most severe compared to the other two scenarios. For low hazard products, the first scenario was most probable and the least severe of the scenarios generated. Practical and theoretical implications of the results are discussed.

INTRODUCTION

How do people distinguish between products that are hazardous and those that are not? The answer to this question has important implications for the prevention of consumer product accidents and the development of effective interventions. Such interventions may involve product redesign and protective barriers (e.g., safety caps). When these are not possible then warnings can be used to promote accident prevention.

In order for warnings to effectively prevent accidents, the warnings must be read. Wogalter, Desaulniers, and Brelsford (1986) report that subjects are more willing to read warnings on more hazardous products and expect such products to have warnings. This suggests that perceptions of hazardousness are important in determining precautionary intentions.

The possibility that consumers may incorrectly perceive the level of hazard is another reason why it is important to study perceptions of product hazardousness. For example, research suggests that people may misperceive the number of deaths associated with a variety of consumer products by overestimating infrequent causes and underestimating frequent causes (Slovic, Fischhoff, & Lichtenstein, 1979; Brems, 1986). An underestimation might lead an individual to be less inclined to engage in precautionary behaviors such as reading warnings and responding appropriately.

The purpose of the present research is to examine components involved in the formation of perceptions of hazardousness of consumer products. There are several possible sources of information that might combine to form such perceptions. For example, it is reasonable to assume that products which 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. Indeed, research by Slovic, Fischhoff, and Lichtenstein (1980a) suggests that perceptions of product hazardousness are determined by some *combination* of information about the severity and the probability of accidents involving a product. The possible contributions of perceived severity and likelihood of injury as predictors of hazardousness are examined in the present research. Moreover, several combinatorial models involving severity and likelihood of injure are explored.

A further component possibly involved in the perception of product hazardousness is product knowledge. It is not unreasonable to assume that more familiar products are perceived to be less hazardous. Previous research suggests that there is a relationship between familiarity and hazardousness, though the research suggests that the relationship is more complex than intuition might suggest (e.g., Godfrey, Allender, Laughery, & Smith, 1983; Godfrey & Laughery, 1984; Wogalter et al., 1986). In addition to familiarity and its relationship to hazardousness, several other knowledge related variables were explored: frequency and time of contact, technological complexity of the product, and perceived confidence in knowing all of the product's hazards.

STUDY 1

Method

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

Materials. The seventy-two generic product names used in the Wogalter et al. (1986) study were used. Each subject was presented with one of four randomly determined product orders. Subjects responded to eight questions for each product. Nine-point Likert-type scales ranging from zero to eight were used for each questions. All even scale values had verbal anchors. Each subject received a unique random ordering of the eight questions. The questions and anchors were as follows:

1) "How *hazardous* is this product?" The anchors for this question were: (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?" The anchors for this question were: (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?" The anchors for this question were: (0) never, (2) unlikely, (4) likely, (6) very

likely, and (8) extremely likely.

4) "How *frequently* do you use this product?" The anchors for this question were: (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?" The anchors for this question were: (0) never, (2) short time, (4) medium time, (6) long time, and (8) very long time.
6) "How *familiar* are you with this product?" The anchors for this question were: (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* ?" The anchors for this question were: (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?" The anchors for this question were: (0) not at all confident, (2) slightly confident, (4) confident, (6) very confident, and (8) extremely confident.

Procedure. Subjects were given one of the four random orders of products. They were told to read the entire list of products to familiarize themselves with the range of products and were given three minutes to examine the list. In order to orient subjects to respond to the products generically rather than to specific brand names, subjects were told to assume that the products were from a new manufacturer or had a new brand name. Subjects rated the entire list of products before moving to the next question.

Results

Several analyses were performed on these data. In the first set of analyses, subject ratings for each of the eight scales were collapsed into mean ratings for each of the 72 products. Of particular interest was the prediction of hazardousness. The bivariate correlations of hazardousness with severity and likelihood were computed. A strong positive relationship between ratings of hazardousness and the expected severity of injury ($r = .89$, $p < .0001$) was found. The likelihood of injury yields a somewhat smaller correlation with ratings of perceived hazardousness ($r = .75$, $p < .0001$). The difference between these correlations is significant ($p < .01$).

Slovic et al. (1980a) have suggested that perceptions of product hazardousness are determined by some *combination* of information about the severity and the probability of accidents involving a product. Several multiple regression models involving severity and likelihood of injury as predictors of hazardousness were examined. The first analysis used an additive model. This analysis showed that once severity is used as a predictor of hazardousness ($r^2 = .79$), likelihood of injury does not increase predictiveness, producing an identical R^2 of .79 when both predictors are present.

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. The variance accounted for 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 hazardousness. This analysis produced an R^2 of .83. The relative increment in variance accounted for compared to the simple linear regression using only severity as the predictor and an additive model using severity and likelihood as predictors is small (.04) but significant (p 's $< .05$).

Several other knowledge variables were examined in regard to their relationship with perceived hazardousness: 1) familiarity, 2) frequency of contact, 3) time of contact, 4) technological complexity, and 5) perceived confidence in knowing all of the product's hazards. The simple correlations of these variables with hazardousness were initially explored. The results show product familiarity is significantly and negatively related to hazardousness ($r = -.36$, $p < .002$). Frequency of contact is negatively correlated with perceived hazardousness ($r = -.27$, $p < .02$). The amount time spent with the products is negatively, but not significantly, related to perceived hazardousness ($r = -.15$, $p > .05$).

In examining the relationship between perceived technological complexity and hazardousness, the results show that products perceived as more technologically complex are also perceived as more hazardous ($r = .35$, $p < .003$). Subjects were also asked how confident they were in knowing all the hazards related to each product. A correlational analysis shows a significant negative relationship to perceived hazardousness ($r = -.40$, $p < .0005$).

Overall, these correlations suggest a negative relationship between people's knowledge of products and perceptions of product hazardousness. Using multiple regression analyses, each variable's relative contribution to the prediction of hazard perception beyond the variance accounted for by a model involving the variables severity, likelihood, and their crossproduct was explored. The analyses indicate no additional predictiveness from the variables familiarity, frequency of contact, and quantity of contact. Only the variables technological complexity and confidence in knowing the hazards add statistically significant variance to the prediction of perceived hazardousness, 2% and 3%, respectively. Simultaneously adding both variables into the prediction equation adds 4%.

Discussion

The results indicate the best single predictor of hazard perception is the severity of injury. Although the simple correlation between hazardousness and likelihood was significant, subsequent multiple regression analyses indicated that the addition of likelihood to severity does not enhance the prediction of hazardousness. However, the further addition of the severity-likelihood crossproduct produces a small but significant increment in predictiveness. That severity, likelihood, and their interaction predicts the greatest amount of variance in perceptions of product hazardousness supports the suggestion of Slovic, Fischhoff, and Lichtenstein (1980a) that perceptions of product hazardousness are determined by some *combination* of information about the severity and the probability of accidents. However, the model involving severity, likelihood, and their interaction provides only slightly greater predictiveness (4%) than a much simpler model involving only severity. Despite the fact that this difference is significant, the importance of this difference is arguable. In terms of applications, severity might be the only important predictor of hazardousness.

The present results also suggest that products that are less frequently used and less familiar are perceived to be more hazardous. On the other hand, these two variable do not enhance the three-factor multiple regression model discussed above. It is interesting to note that a similar result was found by Wogalter et al. (1986). Though familiarity was negatively and significantly related to willingness to read product warnings, when hazardousness was already present in a regression equation, no significant increment in predictiveness due to familiarity was found. However, two other knowledge related variables did contribute significant variance to the predicition of hazard perceptions, ratings of confidence in knowing all the hazards related to the products and the technological complexity of the products. This latter result supports Slovic, Fischhoff, and Lichtenstein (1980a) who report results that suggest that more technologically complex situations are perceived to be more hazardous. Technological advances have produced complex products which might have hidden dangers. Apparently the lack of knowledge about such products' hazards is used in the cognitive formulation of overall product hazardousness.

Speculation might be made with regard to the evolutionary significance of these results. Survival may depend upon precautionary behavior when engaging in things unknown. The perception of hazardousness might well be involved in the determination of such precautionary behavior in humans.

STUDY 2

In Study 1 subjects made overall, abstract judgements of products. Study 2 used a somewhat different technique to examine perceptions of product hazard. In Study 2 subjects generated specific accident scenarios for each product and then rated the scenarios with regard to their severity and probability of injury. The data were examined in regard to perceptions of overall product hazardousness.

There was a further purpose of the second study. Wogalter et al. (1986) reported that, with products of greater hazard, subjects indicate a greater willingness to read product warnings. Reading warnings is one mode of precautionary behavior. The present study further examines the relationship between hazardousness and reported intent to behave in a precautionary manner.

A third purpose was to examine characteristics of the scenarios generated by subjects. Estimated severity and likelihood of potential outcomes are examined as a function of hazard level and scenario order.

Method

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

Materials. The list of 18 products used in this study are shown in Table 1. Products were selected to represent a broad range of perceptions with regard to both severity and probability of potential accidents. A random order of these product names was arranged on the response sheet with spaces for subjects' scenario descriptions and ratings. The materials also included a question sheet which contained a set of instructions and the rating scales. The instructions and rating scales are described in the following section.

Procedure. Subjects were initially given a copy of the response sheet which contained the list of products and were asked to read over the list. Subjects were then given the question sheet which asked the subjects to carry out the following tasks.

The instructions for the first task asked subjects to assume that it was necessary for them to use each of the 18 products listed on the answer sheet. Subjects were asked to "Rate the *degree of precautions* you would take when using each product." Precaution was explicitly defined as "action to ensure safety." A 5-point rating scale was provided. The numerical and verbal anchors were as follows: (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.

In the second task subjects were asked to "Imagine using each product. What *accidents* involving each product would you fear occurring?" Subjects were asked to report the first three accident scenarios that come to mind- - in the order that they come to mind. In doing this they were to describe each accident briefly stating both *how* each imagined accident occurs and the *kind of injury* received. To reinforce this instruction, the response sheet contained two columns labeled HOW and INJURY and three rows for the three accident scenarios. There was no time pressure to complete this task.

In the third task subjects were asked to "Rate the *severity* of each accidental injury" that they reported in the scenario generation task. Space for the ratings were available next to the space available for the scenario descriptions. The rating scale was a 7-point scale containing the following numerical and verbal anchors: (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.

In the fourth task subjects were asked to indicate *how likely* it would be, during their next use of the product, that they would experience the types of accidents and injuries that they had generated in the scenario task. The rating scale was a 8-point scale containing the following numerical and verbal anchors: (1) extremely remote, (2) highly remote, (3) remote, (4) unlikely, (5) possible, (6) probable, (7) highly probable, and (8) almost certain.

In the fifth task, subjects were asked to provide an overall rating of perceived hazardousness of each product. Specifically, subjects were asked, "How *hazardous* do you feel each product is?" The rating scale was a 7-point scale containing the following numerical and verbal anchors: (1) not at all, (2) a little, (3) some, (4) moderately, (5) fairly, (6) very, and (7) extremely.

Results

In spite of the instructions directing subjects to report three accident scenarios for each product, many subjects failed or were unable to report more than one scenario. A total of 1260 observations (70 subjects X 18 products) were possible for each of the three scenarios. For the first scenario, 3% of the observations lacked either (or both) severity and probability ratings. For the second and third scenarios, the number of missing values was much higher, 25% and 54%, respectively.

These data were analyzed in three ways. As in Study 1 one set of analyses used data points that were product means averaged across subjects. The second set of analyses averaged across products to obtain subject means. The third set of analyses used non-averaged data involving the raw responses from all subjects and all products. Where data for an observation was incomplete, the observation was deleted from analysis.

The data used in the first set of analyses were derived from the raw data by collapsing across subjects; product means were entered into the analyses as the random variable. As in Study 1, several models were examined using correlational and regression analyses to predict perceived hazardousness. The correlation between hazardousness and the severity of the first scenario generated is large and significant ($r = .90, p < .0001$). The pattern of the correlations between hazardousness and the severity ratings of the second and third scenario is similar but smaller ($r = .82, p < .0001$, and $r = .72, p < .0001$, respectively). For the first and second scenario the correlations between hazardousness and probability of injury were not significant (p's $> .05$). However, the injury probability of the third scenario and hazardousness yields a positive correlation ($r = .67, p < .003$).

Table 1. Products used in Study 2.

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

Using predictions of hazardousness made from the severity rating of the first scenario as a base, several models of hazardousness prediction were examined in an effort to increase the proportion of variance accounted for. Neither the addition of the probability rating of the first scenario nor the further addition of a crossproduct term to the equation significantly enhanced predictability. Moreover, the severity and probability ratings of the second and third scenario failed to significantly increase the proportion of variance accounted for beyond that accounted for by the first scenario severity rating.

The second set of analyses used subject means (averaged across products) as the random variable. Simple correlations of hazardousness and the scenario ratings shows a reliable relationship between hazardousness and the severity ratings of the three scenarios ($r = .34, p < .004$; $r = .42, p < .0004$; $r = .34, p < .006$) and the probability of injury of the second scenario ($r = .27, p < .03$). The correlations of the other probability ratings were not significant (p 's > .05).

Using the subject means data, several models of hazardousness prediction were examined to see whether or not additional variance, beyond that predicted by the severity rating of the first scenario, might be accounted for. The addition of the first scenario's probability of injury rating significantly increases the prediction of hazardousness (from $r^2 = .12$ to $R^2 = .17$). Also, the addition of the second scenario severity rating to the first scenario severity rating significantly increments hazard prediction (to $R^2 = .18$). Moreover, a model including the linear addition of severity and probability ratings of the first two scenarios significantly increases hazard prediction beyond that provided by the severity rating of the first scenario alone (to $R^2 = .24$). No other regression model significantly enhanced prediction (including analyses with crossproduct terms).

The third data set used the non-averaged raw data, i.e., all subjects and products. Simple correlations between hazardousness and the scenario ratings shows reliable relationships between hazardousness and the severity ratings of the three scenarios generated by each subject ($r = .50, p < .0001$; $r = .38, p < .0001$; $r = .33, p < .0001$). The relationships of hazardousness to the probability of injury ratings for the three scenarios are also significant but these relationships are very small ($r = .06, p < .04$; $r = .08, p < .02$; $r = .14, p < .001$).

As in the earlier analyses, several hazardousness prediction models were examined with regard to the addition of significant variance beyond that attributable to the severity rating of the first scenario. The addition of the first scenario's probability of injury rating produces a small, but significant, increase in hazard prediction (from $r^2 = .255$ to $R^2 = .28$). Also, a model which includes the severity ratings of the first two scenarios and a model with all three severity ratings both significantly increments hazard variance accounted for beyond that accounted for by the first scenario's severity rating alone (to $R^2 = .27$, and to $R^2 = .30$, respectively). The further addition of the probability ratings (as well as more complex terms) to these latter two models containing the first two or three scenario severity ratings did not further enhance hazard prediction.

Another purpose of the present study was to examine the relationship between hazardousness and the degree of precaution subjects would reportedly take when using various products. Using the product means data (averaged across subjects), the correlation is extremely high, $r = .98, p < .0001$. A highly positive relationship is also seen using the subject means data (averaged across products), $r = .74, p < .001$ and using the non-averaged data, $r = .79, p < .001$. Obviously with the large amount of variance in common, it would be expected that both variables (hazardousness and degree of precaution) would have similar predictive models. Regression analyses using the product means data with the severity and probability ratings as predictors of precaution provided a set of virtually identical results to those already reported for the prediction of hazardousness. The pattern was also similar using the other two sets of data.

Interest was also directed to the issue of whether the severity and probability of the generated accident scenarios differ as a function of hazardousness. Hazardousness ratings in each data set were split at the median and recoded to form two groups of high or low hazardousness. A mixed-model ANOVA with a between factor of high vs. low hazardousness and a within factor of the three scenarios was used on the severity and probability ratings for the three sets of data. The probability of injury analysis is discussed first. The probability means are presented in Table 2. The 2 X 3 ANOVA using the product means (averaged across subjects) yields an effect of scenario order, $F(2, 32) = 13.13, p < .0001$. The means on the bottom row of Table 2 show that the earlier generated scenarios are rated as more likely to produce injury than the accident scenarios generated later (Fisher's L.S.D. = .19). However, a significant interaction was also noted, $F(2, 32) = 4.12, p < .03$. For low hazard, the probability of injury for the sequentially generated accident scenarios decreases from the first to the second to the third scenario (Fisher's L.S.D. = .26). For high hazard, there are no significant differences among the scenarios. A similar pattern of results was found using the non-averaged data. The subject means data failed to show significant effects.

The scenario severity data were examined in the same manner as the probability data. Hazard scores in each data set were split at the median to form two groups of high and low hazardousness. A mixed-model ANOVA with a between factor of high vs. low hazardousness and a within factor of the three scenarios was used on the three sets of data. The expected effect of hazard level on severity was shown using the subject means data (averaged across products), $F(1, 65) = 7.50, p < .008$. Analysis of the other two sets of data produced this same effect as well other interesting results. The product severity means as a function of hazard level and scenarios are shown in Table 4. The ANOVA using the product means (averaged across subjects) yielded a main effect of scenario order, $F(2, 32) = 5.90, p < .007$. Examination of the bottom row of Table 4 shows a small, but significant, increase in the severity for the third scenario compared to the first and second (Fisher's L.S.D. = .14). However, the ANOVA also revealed a significant interaction, $F(2, 32) = 34.82, p < .0001$. For high hazard, the first scenario is more severe than the other two scenarios (Fisher's L.S.D. = .20). For low hazard, a different pattern is shown: one of increasing severity from the first to the third scenario. With low hazard, the first scenario is significantly less severe than the second scenario, and the second is significantly less severe than the third. A similar interaction pattern was shown for the non-averaged data, $F(2, 1142) = 8.82, p < .0002$, though there is no significant main effect of scenario order ($F < 1.0$).

Table 2. Mean *probability* of injury as a function of high vs. low hazard level and scenario order.

	Scenario 1	Scenario 2	Scenario 3
High Hazard	3.53	3.38	3.33
Low Hazard	3.68	3.30	2.95
mean	3.605	3.34	3.14

Table 3. Mean *severity* of injury as a function of high vs. low hazard level and scenario order.

	Scenario 1	Scenario 2	Scenario 3
High Hazard	4.70	4.345	4.35
Low Hazard	2.99	3.41	3.79
mean	3.845	3.88	4.07

Discussion

The results of Study 2 show that severity of injury is the primary determinant of the perception of hazardousness for common consumer products. The analyses using product means (averaged across subjects), subject means (averaged across products), and the non-averaged raw data show that in general probability of injury does not play a major role in the perception of hazardousness. Although some of the regression models showed significant increments in prediction beyond that predicted by severity, the increments are very small.

The results also show that perceived hazardousness is highly correlated with the degree of precaution reported by subjects when using the products. Precaution is a broad description of behavior representative of a number of specific behaviors designed to prevent injury when using a product. In addition to many precautionary behaviors that seem to be product specific, another type of precautionary behavior is the reading of warnings. The finding that hazardousness and precaution are highly related provides support for Wogalter et al.'s (1986) finding of greater reported willingness to read warnings on products that are perceived to be more hazardous.

The results also provide information related to the characteristics of accident scenarios generated by subjects. Accident scenarios that subjects generate first are the most probable, particularly for low hazard products. This result is in accord with the predictions of the availability heuristic (Tversky & Kahneman, 1973; Kahneman & Tversky, 1982). This heuristic posits that, when events are more easily recalled, they are judged to be more frequent. Whether the particular accidents recalled first are indeed more frequent can not be answered here. Other evidence (Slovic et al., 1979; Brems, 1986) indicates that subjects tend to overestimate infrequent accidents and underestimate frequent accidents.

The results also indicate that, for high hazard products, the first scenario is more severe than the other two scenarios. This result may also be explained by the availability heuristic (i.e., severe accidents are given greater media attention and are more vivid). For products of low hazard, the earlier scenarios were less severe than the latter scenarios. This result also seems reasonable, since the most probable accidents involving low hazard consumer products tend to be less severe.

GENERAL DISCUSSION

The combined results of Studies 1 and 2 indicate that severity of injury is the primary determinant of perceptions of product hazardousness. In most of the analyses, likelihood or probability contributed little or no additional unique variance to the prediction of hazardousness beyond that accounted for by severity. Likelihood of potential injuries may serve a more indirect role in the perceptions of hazards; probability appears to influence the order in which injury scenarios are generated.

The results have implications for understanding the consumer's perception of product hazards and provide insights into information that might be useful in warning communications. The results indicate that product hazardousness and intent to use precautionary behavior is strongly related. This is fortunate and expected. However, the situation is problematic when a product is perceived to be less hazardous than it really is. For this product, less precautionary behavior might be used than is appropriate to prevent injury. One possible way to communicate the level hazardousness (i.e., the severity of injury) is through warnings. However, subjects in the Wogalter et al. (1986) study report that they would be less willing to read warnings on products they perceive to be less hazardous. This lack of willingness to read warnings on particular products might be countered by the conspicuous placement of salient warnings that attract and capture attention and which convey the seriousness of accidental injury. Recent research on warnings is beginning to illuminate the characteristics that comprise effective warnings which would aid in this regard (e.g., using appropriate signal words, pictorials, etc.).

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