Relative Contribution of Likelihood and Severity of Injury to Risk Perceptions

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ABSTRACT

The degree of caution that people are willing to take for a given product is largely determined by their perceptions of the risk associated with that product. Research suggests that risk perceptions are determined by the objective likelihood or probability of encountering potential hazards (Slovic, Fischhoff, and Lichtenstein, 1979). However, there is also research suggesting that objective likelihood plays little or no role in determining risk perceptions. Rather, risk is determined by the subjective dimension of the hazard or in other words, the severity of injury (Wogalter, Desaulniers and Brelsford, 1986, 1987). The present research examined aspects of these two studies in an attempt to reconcile the observed differences. Subjects evaluated either the Wogalter et al. (1986, 1987) products or the Slovic et al. (1979) items on eight rating questions. Results demonstrated that severity of injury was the foremost predictor of perceived risk for the Wogalter products, but that likelihood of injury was primarily responsible for ratings of risk for the Slovic items. The two lists differed substantially on all the dimensions evaluated, suggesting that the content of the lists is responsible for the contrary findings. In a second study, subjects rated another set of generic consumer products. These ratings showed a pattern of results similar to the Wogalter products. Overall, this research: (a) explains the basis for conflicting results in the risk perception literature, and (b) demonstrates that severity of injury, and not likelihood of injury, is the primary determinant of people's perceptions of risk for common consumer products.

INTRODUCTION

The degree of caution that people are willing to take for a given product is largely determined by their perceptions of the risk associated with that product. Risk is defined as "the chance of injury, damage, or loss" (Webster's New Universal Unabridged Dictionary, 1983) and this definition suggests that risk is an objective, probabilistic term: the *likelihood* ("chance") that a negative consequence will occur. Following this thinking, early research recommended that the proper way to motivate people to act with caution is to provide them with information that gives "an appreciation of the probabilistic nature of the world and the ability to think intelligently about rare (but consequential) events" (Slovic, Fischhoff, and Lichtenstein, 1980, p. 167). However, this has been very difficult to implement in research and in practice because of substantial and inevitable biases in the way people use likelihood information (Lichtenstein, Slovic, Fischhoff, Layman, and Combs, 1978). In addition to these biases, Desaulniers (1991) demonstrated that people cannot really differentiate between small probabilities (e.g., 1/10,000 and 1/100,000). These studies suggest that people do not (or are not able to) use likelihood information in a systematic manner.

If this is true, then how are perceptions of risk formed and used? The definition of risk given above suggests more subtly that there is a second, generally *subjective* component of risk: the dimensions of the "injury, damage, or loss" (i.e., *severity* of the injury). Wogalter, Desaulniers, and Brelsford (1986, 1987) and Wogalter, Brelsford, Desaulniers, and Laughery (1991) demonstrated that perceptions of risk were composed primarily of the severity of injury associated with a product and not the likelihood of that injury. These studies, as well as others (i.e., Young, Martin, and Wogalter, 1989; Young, Brelsford, and Wogalter, 1990), suggest that likelihood estimations do not contribute to people's judgments of risk. Rather, it is the perception of severity of injury that largely determines the degree of caution people are willing to exhibit.

Thus, some research suggests that likelihood of injury plays an important role in the determination of risk perceptions, whereas other research suggests that severity of injury is the principal component of risk. One potential reason for these differences is the nature of the words used to assess perceptions of risk. Specifically, the Wogalter studies used the term "hazard", while the Slovic studies used the term "risk". However, Young, Brelsford and Wogalter (1990) showed that there were *no* differences between these terms in the evaluation of risk perceptions. Thus, we are very confident that the Wogalter and Slovic studies were investigating the same construct and that the specific terms used to assess perceived risk is not responsible for the differences between the two studies. An additional difference between the Wogalter and Slovic studies is the content of the item lists that subjects evaluated. Wogalter et al. (1986, 1987) used a broad range of household consumer products; whereas Slovic et al. (1979) used some consumer

products, but also included technologies and activities (e.g., nuclear power and mountain climbing). The differences in the nature of the item lists is the focus of the present paper.

STUDY 1

This study examines the nature of the two lists used by Wogalter et al. (1986, 1987) and Slovic et al. (1979) in order to assure that the respective findings are replicable and to determine whether they differ with respect to the relative contributions of injury likelihood and severity to risk perceptions.

Method

Subjects. Forty undergraduate students from the University of Houston participated in this experiment for credit in an introductory psychology class.

Materials. Table 1 shows the two lists of items that were used. Half of the subjects were exposed to the 72 products employed by Wogalter et al. (1986, 1987) and the other half were shown the 30 products, technologies and activities used by Slovic et al. (1979). The order of the products and items were randomized. Table 2 shows the 8 questions that subjects used to rate items. All scales employed 9-point Likert-type rating scales anchored from 0 (absence of a quantity) to 8 (maximum quantity). Five of the questions (Questions 1, 2, 4, 5, and 6) were taken from and are unique to Wogalter et al. (1986, 1987), whereas, the last two were unique to Slovic et al. (1979). Question 3 was common to both studies. The questions were slightly reworded to accommodate products, technologies *and* activities, thus allowing the same questions to be used regardless of the item list that was presented to subjects. Also, it should be noted that Question 1 (Hazard) is used to assess risk perceptions, primarily because we have used this question many times before and because "hazard" has been shown to be equivalent to the term "risk" (Young et al. 1990). In the booklets, each question was printed on a separate page and the pages were randomly ordered.

Procedure. Subjects received one of the two lists and were told to rate the items for each question before going on to the next question. They were also instructed to make their ratings according to the order that the questions were presented in the booklet.

Results

Product differences on the 8 questions. Analyses initially compared the two item lists with respect to the mean ratings on the 8 questions. The lists differed significantly on all 8 rating questions ($ps < .05$, see the first two columns of Table 3). The 30 items were perceived to be more hazardous and less familiar than the 72 products. In general, subjects reported that they were more likely to be injured by the 30 items and that those injuries would be more severe and more catastrophic than with the 72 products. In addition, subjects reported greater intent to act cautiously and greater likelihood to read warnings for the 30 items than for the 72 products, at the same time believing that they had less control over being injured with the 30 items.

Table 1. A listing of the 72 Wogalter et al. (1986, 1987) products and the 30 Slovic et al. (1979) items.

Wogalter et al. (1986, 1987) products

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

Slovic et al. (1979) items

bicycle	hunting	general (private) aviation	food preservatives	H.S. & college football
food coloring	railroads	skiing	handguns	pesticide
commercial aviation	X-rays	motorcycles	prescription antibiotics	spray can
motor vehicles	nuclear power	contraceptives	fire fighting	home appliances
mountain climbing	large construction	smoking	alcoholic beverage	lawn mower
swimming	vaccinations	surgery	electric power	police work

Table 2. A list of the 8 rating questions and their anchors.

1) **Hazard**: "How *hazardous* is this product, technology or activity?" The anchors for this question were: (0) not at all hazardous, (2) slightly hazardous, (4) hazardous, (6) very hazardous, and (8) extremely hazardous.

2) **Likelihood**: "How *likely* are you to receive *any* injury with this product, technology or activity, including all *minor* ones (requiring little or no first aid) and *major* ones (requiring emergency room treatment)?" The anchors for this question were: (0) never, (2) unlikely, (4) likely, (6) very likely, and (8) extremely likely.

3) **Severity**: "How *severely* (i.e., degree, extent or magnitude) might you be injured by this product, technology or activity?" The anchors for this question were: (0) not at all severe, (2) slightly severe, (4) severe, (6) very severe, and (8) extremely severe.

4) **Cautious Intent**: "How *cautious* would you be when using this product or technology or while doing this activity?" The anchors for this question were: (0) not at all cautious, (2) slightly cautious, (4) cautious, (6) very cautious, and (8) extremely cautious.

5) **Likelihood of Reading Warnings**: "If you *saw* a warning on this product or during this activity, how *likely* would you be to read it?" The anchors for this question were: (0) never, (2) unlikely, (4) likely, (6) very likely, and (8) extremely likely.

6) **Familiarity**: "How *familiar* are you with this product, technology or activity?" The anchors for this question were: (0) not at all familiar, (2) slightly familiar, (4) familiar, (6) very familiar, and (8) extremely familiar.

7) **Control**: "If exposed to the risks, to what extent can you, by personal skill or diligence, avoid the hazards associated with this product, technology or activity? That is, how much control do you have over being injured by this product, technology or activity?" The anchors for this question were: (0) no control at all, (2) some control, (4) control, (6) much control, and (8) total control.

8) **Catastrophe**: "Are the risks associated with this product, technology or activity the kind that injure or kill people one at a time or are they risks that injure or kill large numbers of people at a time?" The anchors for this question were: (0) injures/kill one at a time, (2) injures/kill a few at a time, (4) injures/kill several at a time, (6) injures/kill many at a time, and (8) injures/kill large numbers at a time.

Table 3. Means of the 30 items and 72 products (Study 1) and the 85 products (Study 2)

Questions	Mean Rating		
	30 Items (Study 1)	72 Products (Study 1)	85 Products (Study 2)
Hazardousness	3.74	2.66	2.89
Likelihood	3.42	2.41	2.51
Severity	5.03	3.08	3.39
Cautious Intent	4.81	2.80	2.87
Likelihood of Reading Warnings	5.11	3.64	3.72
Familiarity	3.89	3.96	4.57
Control	4.13	5.29	5.44
Catastrophe	2.38	0.64	0.95

Regression analysis with the 72 products. Regression analysis using hazard (risk) ratings as the criterion variable was performed on the 72 products. Scores for the analysis were means for items derived by collapsing across subjects within each scale. The greatest overall predictor of hazard was severity ($r = .973$), which accounted for 94.7% of the variance. Catastrophe contributed significant additional variance, increasing the total explained variance to 95.3%.

Regression analysis with the 30 items. Scores for the regression analysis on the 30 items was derived similar to the 72 product analysis. The 30-item regression analysis demonstrated that likelihood was the single best predictor of hazard, accounting for 86.6% of the variance. Familiarity made a significant contribution in addition to likelihood, augmenting the amount of explained variance to 88.9%.

Analysis of common products. Four products on the list used by Wogalter et al. (1986, 1987) were identical to product names used in the Slovic et al. (1979) list: bicycle, lawn mower, pesticide, and alcoholic beverage. These items were compared between lists to identify any contextual effects that might have influenced ratings. The results demonstrated that there were large and significant differences between ratings for the lawn mower and pesticide on the two lists (see Table 4). In general, potential injuries associated with the lawn mower and pesticide were considered less hazardous, less likely, and less severe when evaluated in the context of the Slovic products (compared to the Wogalter products). Also with these products, subjects reported that they would be less likely to read warnings or behave with caution when the items were presented in the Slovic list. The differences between product lists for alcoholic beverage and bicycle were smaller than with lawn mower or pesticide. These results suggest that, for some products, context influences perceptions.

Discussion

In previous research, severity of injury has been found to be the foremost predictor of risk perceptions. This finding has been reproduced again using the 72 products from Wogalter et al. (1986, 1987). Likelihood was not found to contribute significantly above and beyond severity. However, likelihood played a major role in determining perceived risk for the less familiar, more hazardous and more severe 30-item list of Slovic et al. (1979). It is possible that the effects found for each list are limited entirely to the stimuli employed in this study and that no generalization can be made beyond the content of these particular lists. However, the large and apparent qualitative differences between the two lists suggests that the 72 products may be more representative of consumer products in general than the 30 item list. These results also demonstrate that ratings for the common products in the lists were significantly influenced by the nature of the list in which it is included. For two of the common products (lawn mower and pesticide), perceptions varied considerably but consistently

between product on different lists. This suggests that perceptions of risk are subject to contrast effects with surrounding items.

STUDY 2

The Slovic et al. (1979) item list was shown to differ significantly with the list of products used by Wogalter, et al (1986). This is not entirely surprising considering that 57% of the Slovic et al. items are not consumer products at all. Based on this fact alone, it would seem reasonable to assume that the findings for the 72-product list would be more generalizable to consumer products than the 30-item list. While the 72-product list has been used in several previous studies, there has been no evaluation of whether the products on this list are representative of all common consumer products that people might use in their daily lives. Stronger conclusions could be made if similar effects were to be found using other products. Thus, Study 2 employed a different list of common consumer products to determine whether severity of injury is the foremost predictor of risk perceptions and whether likelihood is again relatively less important. The ratings on this newer list are compared to the ratings of the two lists used in Study 1.

Method

Subjects. Thirty-five undergraduates subjects from Rice University participated in this study for credit in an introductory psychology course.

Materials and procedure. Table 5 shows a list of 85 product names that were chosen at random from a list of over 950 products monitored by the National Electronic Injury Surveillance System (NEISS; U. S. Consumer Product Safety Commission, 1989). Four random orders of the list were created and the products were listed on two pages. The 85 products were rated on the same 8 questions used in Study 1. Other aspects of the method were identical to those employed in Study 1.

Results

Means on the 8 questions. The mean ratings of the eight questions for the 85 products were very similar to the pattern

Table 4. Means for the common products between Wogalter et al. (1986, 1987) and Slovic et al. (1979).

	Alcoholic Beverage		Bicycle		Lawn Mower		Pesticide	
Questions	Wogalter	Slovic	Wogalter	Slovic	Wogalter	Slovic	Wogalter	Slovic
Hazardousness	5.70	4.80	2.70	2.05	4.55	1.80*	5.95	3.65*
Likelihood	5.00	3.50*	3.70	3.25	3.60	2.20*	3.42	3.15
Severity	6.35	5.65	4.40	3.90	5.00	3.60*	5.74	4.30*
Cautious Intent	5.65	5.00	3.35	3.60	4.25	2.85*	5.32	3.80*
Likelihood of Reading Warnings	4.10	3.90	3.15	2.35	5.30	3.80*	6.58	5.25*
Familiarity	6.40	5.10*	7.35	7.15	5.90	6.00	4.42	3.60
Control	5.10	6.15	5.10	5.60	5.00	6.25*	4.47	3.15*
Catastrophe	5.40	3.35*	0.80	0.35	0.95	0.15	4.79	2.90*

* Indicates a significant difference between lists on this question ($p < .05$)

Table 5. A listing of the 85 products from the NEISS product list.

cribs	dune buggies	log splitters	toboggans	4 wheel ATV's
darts	diapers	lawn mowers	garage doors	benches
artificial Christmas tree	lighter fluid	baby bathinett	seeds	liniments
bleachers	bicycles	hot water	glass test tubes	pogo sticks
inflatable toys	hair clippers	pens and pencils	hair coloring	power sanders
power pruning equipment	padlocks	rope or string	toy weapons	pins and needles
toy cosmetics	snow blowers	toy sports equipment	children's play tents	saunas
clotheslines	luggage	electric toy cars	aerosol containers	ice crushers
food processors	orthopedic beds	manual lawn trimmers	laundry soaps/detergents	scissors
footlockers	chemistry set	tables	slow cookers	pressure cookers
gas water heater	bench/table saw	bubble baths	food warmers	workshop staples
wire	furniture polishes	swimming pool equipment	whirlpool/hot tubs	burglar alarms
built in swimming pools	laundry baskets	rust preventatives	sabre saws	blankets
hair dryers	pull down/folding stairs	glass bottles/jars	upholstered chairs	treehouse/playhouse
kerosene/oil heaters	can openers	drinking straws	rug shampooer	hay processing equipment
windshield wiper fluid	clothes dryer	beds	sheets or pillowcases	food grinders
gasoline cans	solid room deodorizer	household cleaners	abrasive cleaners	windows

of means observed for the 72 products (see Table 3). Comparisons between the means for the 85-product list in this study and the two lists from the first study showed that the 85-product list was statistically different from the 30-item list on every one of the 8 rating questions. In contrast, the 85-product list differed from the 72-product only on the familiarity dimension, where subjects reported being less familiar with the 85 than with the 72 products. Thus, it appears that the 85 products in this study are perceived to be (statistically) more similar to the 72 products used by Wogalter et al. (1986, 1987) than the 30 items used by Slovic et al. (1979).

Regression analyses

A regression analysis was performed on the 85 products using mean product scores collapsed across subjects. The single best predictor of hazard was severity ($r = .958$), accounting for 91.8% of the variance. The dimension of control contributed a small but significant amount of additional variance (0.8%).

Discussion

The results of Study 2 are very similar to the findings for the Wogalter products in Study 1. The means for the 8 rating questions were almost identical between the 85 and the 72 products. In addition, these two lists showed a similar pattern of results with regard to the substantial relationship between severity and risk perceptions.

GENERAL DISCUSSION

These results suggest that, for common consumer products, severity of injury is the single best predictor of risk perceptions. In two separate lists of products (the 85 and 72 product lists), severity of injury was shown to be the foremost predictor of hazard. Even though the two product lists were very different in terms of specific content, they exhibited a strikingly similar pattern of results. This suggests that severity of injury is probably the single best predictor of risk for many (if not most) common consumer products. We have no evidence to suggest that likelihood plays a part in people's perceptions of these products. The fact that severity was not a major predictor with Slovic et al.'s (1979) 30 items appears to result from the fact that they are substantially and qualitatively different from the kinds of items that most people encounter on a daily basis.

A tentative hypothesis can be made regarding why severity and likelihood are important in the different lists: People use severity information when forming perceptions of risk because severity is valuable and sufficient in most cases, involving greater use of heuristic processing than likelihood information (Desaulniers, 1991). However, when severity of the potential consequences reaches a certain level (i.e., *very* severe injury or death), the only remaining uncertainty about the outcome is the probability of the dreadful event. For example, people's fear of plane crashes or nuclear disasters is based, not just on the severity of the potential consequences, but mostly on the probability of the event. Whether correct or incorrect, people generally perceive these events to be cataclysmic, with virtually no uncertainty about the severity of the disaster. In these cases, likelihood would be expected to play a role in risk assessments. It is possible that Slovic's list included many items which approached or surpassed this severity threshold (i.e., nuclear power, commercial aviation, fire fighting, surgery, X-rays, smoking, etc.) and thus produced an effect of likelihood.

The two studies presented here provide a basis for resolving discrepancies between the findings of Slovic and Wogalter. These results suggest that if one is rating items which are (on the whole) very hazardous, very likely to result in injury, very severe, very unfamiliar and very catastrophic, likelihood of injury will be an important variable in the formation of risk perceptions, and subsequently, people's intent to act cautiously. However, these attributes are not associated with the products that consumers generally use, and they may not play a role in people's risk perceptions in everyday situations.

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