Effect of Container Shape on Hazard Perceptions

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ABSTRACT

People may make assumptions about the hazard levels of products based on the physical characteristics of the container. One primary physical characteristic of a container is its shape (configuration). For example a container appearing similar to a carton of milk might be assumed to hold a less hazardous substance than would a paint can. The present study examined 17 container shapes, presented to participants as line drawings, on various dimensions including perceptions of hazard, likelihood of reading the label, ease of dispensing, and familiarity. The results showed that different container shapes evoke different levels of hazard perception. Container shapes connoting higher hazard were also those that people reported greater willingness to read the label and represented containers that were more difficult to dispense. Hazard perception and container familiarity significantly contributed to the prediction of likelihood of reading the label. Implications for further research and hazard control are discussed.

INTRODUCTION

Generally manufacturers want to make products that are as safe as possible. Ideally they will try to design out or guard against potential dangers so that users do not come in contact with the hazard. Sometimes this cannot be accomplished because of the nature of the product and in such cases the manufacturer may attempt to increase safety using warnings. However, people do not always read warning labels for products that they purchase and use (DeJoy, 1989). This creates a potential health and safety problem because the hazardous nature of many kinds of products are not always apparent, particularly chemicals. A clear fluid may be non-toxic (e.g., water) or it might be extremely poisonous (e.g., drain cleaners). One way to potentially draw attention to a label and perhaps convey the hazardous nature of a chemical product is by the shape or configuration of the packaging or container that holds the chemicals. Some container shapes might serve as a cue to the type and extent of the hazard of the product it contains. A paper carton commonly used to hold milk suggests that whatever substance it contains is relatively safe. Whereas, a 55 gallon drum of some fluid suggests a substance for industrial use that could be hazardous. Therefore, people may make assumptions of the potential danger just by the appearance of the container.

Research indicates that different shapes can cue varying levels of hazard. For example, Riley, Cochran, & Douglass (1982) found that a two dimensional shape of a triangle pointing downward, followed by a square and other shapes connoted more hazard than rounded shapes. The increasing use of symbols as a substitute for or in conjunction with verbal text messages is another indication of shapes having utility in conveying hazard (e.g., Dewar, 1994; Sojourner & Wogalter, 1997). However, research is equivocal in that some research does not find differential effects of shape (Barlow & Wogalter, 1991; Jaynes & Boles, 1990) or pictorials (Wogalter, Kalsher, & Racicot, 1993).

In a study that tested various container shapes on their attractiveness to children, Schneider (1977) failed to find statistically significant differences between round, triangular, and a square-shaped containers. However the lack of significant differences might be due to the simple shapes they used or the fact that the sample size was relatively small.

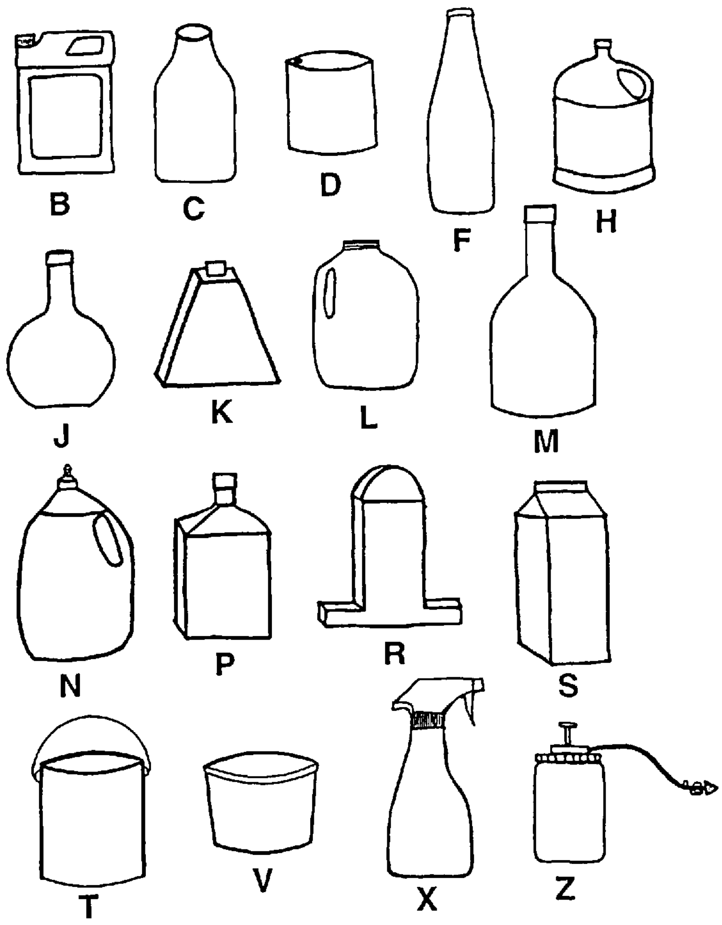
The present study examined people's judgments of various container configurations to determine whether the shapes elicit differential responses. The dimensions evaluated include perceptions of hazard familiarity, willingness to read the label, and convenience in dispensing the contents.

METHOD

Participants

In the preliminary phase of the study, 15 volunteers from the Raleigh, North Carolina area were recruited to draw pictures of containers that would signal users that it contained an extremely hazardous substance by virtue of the its exterior

Figure 1. *Representations of the Container Stimuli*



physical shape. In the rating phase of the study, 44 undergraduates (29 males and 15 females with a mean age of 21.5 years, SD = 6.3) from North Carolina State University participated for credit in introductory psychology courses. Eighty percent were Caucasian; 18% were African-American and 2% were Asian.

Materials

Seventeen black and white line drawings of containers were used as stimuli. These shapes are shown in Figure 1. Four containers (K, P, R, and Z) were selected from the drawings created by participants in the preliminary phase of the study. The other 13 were drawings of common containers used to hold various liquid-based products currently available in the marketplace. The drawings were digitally scanned into computer graphics software. The sizes were adjusted so that the drawings were approximately equal in order to avoid confounding influences of volume. None of the containers included labels that might bias judgments. The containers were assigned a random letter label that was printed in conjunction with each drawing. Each drawing was laser printed onto individual 21.6 X 27.9 cm (8.5 X 11 inch) white sheets. The 17 sheets were compiled into booklets and were randomized for each participant presentation.

A questionnaire was developed that contained 10 questions:

(a) *Hazardous Contents:* Based on the shape of this container, how hazardous would you rate its contents?

(b) *Hazardous to Eat or Drink:* Based on the shape of this container, how hazardous would its contents be to eat or drink?

(c) *Hazardous to Inhale:* Based on the shape of this container, how hazardous would it be to inhale its contents?

(d) *Hazardous Skin Contact:* Based on the shape of this container, how hazardous would it be if it contacted the skin?

(e) *Hazardous to Children:* Based on the shape of this container, how hazardous would it be around children?

(f) *Hazardous in Closed Spaces:* Based on the shape of this container, how hazardous would it be to use in closed space?

(g) *Flammable/Combustible Hazard:* Based on the shape of this container, how likely would it be that it would hold a flammable/combustible substance?

(h) *Read Label:* If this product had a label, how likely would it be that you would read it?

(i) *Familiarity:* How familiar are you with this container?

(j) *Easy to Dispense:* Based on the shape of this container, how easy would it be to dispense its contents appropriately?

Each item was associated with a 9-point Likert type scales with 0 indicating minimum and 8 indicating maximum quantity on the dimension. A response sheet was constructed with a series of letter labels that corresponded to the container letter labels. A standard demographics questionnaire was used that asked age, gender, and ethnicity/race.

Procedure

In the preliminary phase, the 15 participants were asked to draw containers for a very hazardous substance. They were first presented with the following scenario:

"You are employed by Corolaxide, Inc., a leading industrial manufacturer. Your company has asked you to design a container for a new, but extremely hazardous liquid material that it will manufacture. You are to design a container that will signal to users that the contents are extremely dangerous. Consider that some members of the potential consumer base may not be able to read. Draw as many different designs as you like. Please draw them as clearly as possible."

From the designs drawn by the participants participants, four were selected to be used in the rating experiment. The other set of 13 pictures were of containers shapes that hold common liquid chemical formulations currently available in the consumer product marketplace.

In the rating phase, participants were asked to rate the 17 container shapes according to the 10 questions described above. Participants were asked to rate each container on all of the questions before turning the page to the next container. They were directed to mark their responses at the appropriate locations on the response sheet. After rating all of the containers, they completed the demographic questionnaire. Participants were subsequently debriefed and thanked.

RESULTS

The mean ratings for the questions as a function of container shapes are shown in Table 1. The data show the ratings for the seven hazard scales were relatively consistent. Pearson correlations between these items ranged from.84 to .98. Given that they appear to be measuring the same underlying dimension, and to make exposition of the remaining analyses more succinct, a new variable was computed composed of a mean of the seven separate hazard questions shown in Table 1. This new variable, called perceived hazard, is shown in Table 2. It was used in subsequent analyses.

One-way repeated measures analyses of variance (ANOVAs) on this newly-derived perceived hazard measure and the data for the other three questions (read label, familiarity and dispensing) were conducted. All 4 ANOVAs showed significant outcomes: for perceived hazard, $F(16, 688) = 60.66, MS_e = 2.64, p < .000$; for likelihood of reading a label, $F(16, 688) = 4.91, MS_e = 4.26, p < .0001$; for familiarity, $F(16, 688) = 25.78, MS_e = 3.89, p < .0001$; and for ease of dispensing, $F(16, 688) = 10.96, MS_e = 4.73, p < .0001$. Given the 17 shapes, the number of possible paired comparisons among conditions is 136. Because this number is large, a Bonferroni correction was employed which indicated the use of an alpha level of .0004 as the criterion for significance. Using this p value, the least significant difference (LSD) between any two shape conditions were: for perceived hazard the LSD = 1.23, for likelihood of reading a label the LSD =1.57, for familiarity the LSD = 1.50, and for ease of dispensing the LSD =1.65. As can be seen in the Table 2, certain container shapes elicited consistently high hazard ratings (Z, B, D, T, and H) and others elicited consistently low hazard ratings (S, C, L, F, and V). A similar

Table 1. *Mean Ratings for the Seven Hazard Questions as Function of Container.*

	Hazard Questions						
Container	Contents	Eat/Drink	Inhale	Skin Contact	Children	Closed Spaces	Flammable
B	5.36	7.09	4.93	3.91	6.39	3.84	5.70
C	0.32	0.25	0.41	0.27	0.61	0.27	0.32
D	4.61	5.95	4.59	3.52	5.57	4.36	5.95
F	0.52	0.39	0.27	0.05	1.36	0.14	0.73
H	4.57	6.05	4.39	3.55	5.68	3.30	2.86
J	2.77	4.18	2.82	1.93	4.05	1.80	2.70
K	2.39	4.43	2.39	1.16	3.45	1.66	2.95
L	0.39	0.34	0.61	0.18	0.55	0.23	0.36
M	2.52	3.23	1.84	1.39	4.09	1.34	2.77
N	2.02	4.66	1.43	0.64	3.20	0.57	0.80
P	3.16	3.95	2.07	1.34	4.61	1.77	3.43
R	2.05	3.61	1.86	1.77	3.05	1.45	1.86
S	0.18	0.05	0.18	0.05	0.27	0.09	0.05
T	4.43	6.41	5.34	1.93	5.43	4.77	4.70
V	0.66	1.39	0.66	0.48	1.30	0.45	0.43
X	4.16	5.95	3.84	2.09	5.23	2.61	2.50
Z	6.48	7.23	5.68	5.50	6.89	5.66	4.93

pattern can be seen for likelihood of reading the label which was highly correlated with hazard perception ($r = .82$, $p < .0001$). The pattern is less consistent with ease of dispensing which had a lower relation with hazard perception ($r = .54$, $p < .05$). The containers easiest to dispense were C, F, and N; the containers most difficult to dispense were D, R, and T. A non significant inverse relation was found between hazard perception and container familiarity ($r = -.22$, $p > .05$). The most familiar containers were S, F, and X; the least familiar containers were K, R, and D.

Multiple regression analysis with likelihood of reading the label as the criterion variable showed perceived hazard and container familiarity contributed significantly to its prediction ($R^2 = .76$, $p < .0001$); dispensing ease did not.

Table 2. *Mean Ratings for the Derived Perceived Hazard Measure and the Three Non-Hazard Questions.as Function of Container*

	Questions			
Container	Perceived Hazard	Willing to Read Label	Familiar	Easy to Dispense
S	0.12	3.18	6.91	5.93
C	0.35	4.11	5.05	6.32
L	0.38	3.84	5.41	4.86
F	0.49	3.75	6.30	6.18
V	0.77	3.39	4.64	4.66
N	1.90	3.59	5.95	6.02
R	2.24	4.52	1.66	3.05
M	2.45	4.55	4.11	5.27
K	2.63	4.23	1.66	3.73
J	2.89	4.77	3.55	4.98
P	2.91	5.02	3.73	4.86
X	3.77	4.05	6.05	5.93
H	4.34	4.91	5.20	4.57
T	4.72	4.23	6.00	3.45
D	4.94	5.16	3.27	2.84
B	5.32	5.27	4.50	4.23
Z	6.05	5.55	4.64	4.66

DISCUSSION

The results showed that people's perceptions of container shapes influence judgments of perceived hazard. Although actual containers were not displayed, people apparently used the basic outline shapes representing the containers as a cue to the contents' level of hazard. Rhoades et al. (1990) note that the knowledge people apply when using the product often comes from sources other than the accompanying documentation. They also suggest that product development should consider user knowledge and patterns of behavior in the absence or partial absence of printed product information. People's pre-existing schemas and scripts about products in certain kinds of containers could lead to false assumptions about the product and how to safely transport, store, and use it. If a manufacturer fills a container with a more dangerous chemical than people expect it to contain, then users might not employ adequate precaution which could lead to injury. The perceptions, whether correct or incorrect, are probably based on previous experience with known products in a similar container. The lower hazard-connoting containers looked like containers of liquid food products (e.g., S which resembled a milk carton or F which resembled a soda bottle). The higher hazard-connoting shapes resembled a TNT dynamite detonator (Z) and a grave stone (R). It might be noted that containers X and Z were the only ones of the set that included visible applicator tops (a pump spray top and hose). They were included in the depictions because they tend to almost always co-occur with the rest of the container. Unfortunately, it can not be determined from this study whether perceptions of these containers would be significantly different had they been tested without the top apparatus.

At least two approaches might be considered when attempting to reduce potential misconceptions of hazards associated with chemical containers. The first is to use a container that matches the perceived hazard to the actual chemical hazard (and this may require a novel container shape). For example, it would be inappropriate and dangerous to package a hazardous petroleum-based product in a milk-carton type container. A second approach is to have labeling that catches the attention of users and conveys the appropriate level of hazard. A large body of empirical research in the human factors/ergonomics literature provides information on characteristics that facilitate warning label effectiveness (Laughery, Wogalter, & Young, 1994).

The results also indicated that the variable willingness to read the label could be predicted to a substantial degree from hazard perceptions and container familiarity. This finding suggests that motivating people to read the labels of products with new more dangerous formulations could be facilitated by using a container with a novel shape with high connoted hazard.

The belief that container shape can cause misperception was highlighted in the late 1980s to early 1990s with the introduction of Cisco® wine (Canandaigua Wine Company, Canandaigua, NY). Cisco was bottled in containers shaped like those of wine cooler bottles (resembling container F in Figure 1), but the beverage actually had four to five times the alcohol as wine coolers (20% vs. 4-5% alcohol by volume).

Apparently some individuals mistakenly purchased and drank Cisco® under the assumption that they were consuming a low alcohol beverage only to find themselves much more intoxicated then they expected. After a series of news reports of several consumers nearly dying from alcohol poisoning and numerous complaints from consumer advocacy groups to the company and the U.S. Bureau of Alcohol, Tobacco, and Firearms, the manufacturer was pressured into changing the container's shape. The subsequent shape of Cisco® wine bottles is similar to container M in Figure 2.

The present study is an initial investigation concerning people's hazard perceptions of chemical containers. Additional investigations could examine the effects of other factors including color and various aspects of the product label (e.g., product name, warnings) to determine whether these factors work in concert or interact with container shape.

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