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Influence of Warning Label Signal Words on Perceived Hazard Level

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This experiment investigated the influence of warnings, signal words, and a signal icon on perceived hazard of consumer products. Under the guise of a marketing research study, 135 people (high school students, college students, and participants from a shopping mall) rated product labels on six dimensions, including how hazardous they perceived the products to be. A total of 16 labels from actual household products were used: 9 carried the experimental conditions, and 7 were filler product labels that never carried a warning. Five conditions presented the signal words NOTE, CAUTION, WARNING, DANGER, and LETHAL together with a brief warning message. In another two conditions, a signal icon (exclamation point surrounded by a triangle) was presented together with the terms DANGER and LETHAL. In the final two conditions, one lacked a signal word but retained the warning message, and the other lacked both the warning message and the signal word. Results showed that the presence of a signal word increased perceived product hazard compared with its absence. Significant differences were noted between extreme terms (e.g., NOTE and DANGER) but not between terms usually recommended in warning design guidelines (e.g., CAUTION and WARNING). The signal icon showed no significant effect on hazard perception. Implications of the results and the value of the methodology for future warnings investigations are discussed.

INTRODUCTION

Most standards and guidelines on warning design recommend the inclusion of signal words in labels and signs to alert people that a hazard is present and to indicate the degree of danger involved (e.g., American National Standards Institute, 1991; FMC Corporation, 1985; Westinghouse, 1981). The standards usually recommend the terms DANGER, WARNING, and CAUTION to denote the highest to lowest levels of hazard, respectively. In recent years, research has begun to examine the validity of these guidelines. Do people actually interpret differences between signal words? Research on this question is equivocal. Leonard, Matthews, and Karnes (1986) reported no reliable differences between risk ratings of the terms DANGER, WARNING, and CAUTION. In addition, Wogalter et al. (1987) found no difference

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between the terms WARNING and NOTE in a behavioral effectiveness study. However, other studies (Bresnahan and Bryk, 1975; Dunlap, Granda, and Kustas, 1986) have shown reliable differences of connoted hazard between such terms as DANGER and CAUTION.

In recent research, Wogalter and Silver (1990) examined 84 potential signal words (e.g., LETHAL and TOXIC) and specifically studied the level of hazard conveyed by the three most common signal words (DANGER, WARNING, and CAUTION) plus five other terms that had been evaluated in earlier research. The results showed that DEADLY, DANGER, WARNING, CAUTION, CAREFUL, ATTENTION, NOTICE, and NOTE conveyed the greatest to least hazard, respectively. All of the terms were significantly different from one another except ATTENTION/CAREFUL and WARNING/CAUTION. In a follow-up study, Silver and Wogalter (1991) found similar results using elementary and junior high school students.

All of these studies used internally valid methodologies; however, they used testing procedures that lack the realism and ecological validity of an appropriate context. In particular, the researchers had participants evaluate the terms in the absence of any relevant context (i.e., either alone or as part of a word list). When tested in isolation, signal words could show effects that do not transfer to conditions of greater realism, such as when they are accompanied by a warning message and other product label information.

The current study presents signal words in the context of warnings on consumer products labels—a more realistic method to assess their influence than previously employed. In addition, the experiment was performed under the guise of a marketing research study in which participants were asked to examine labels of several products and answer a series of questions about each product. Of the six questions asked, the one that requested ratings of perceived hazard was of primary interest.

Judgments of hazard were assessed because previous research shows that this concept is particularly important in relation to product warnings. Several studies indicate that people's hazard perceptions are strongly and positively linked to both willingness to read warnings (Godfrey, Allender, Laughery, and Smith, 1983; Wogalter, Brelsford, Desaulniers, and Laughery, 1991) and compliance behavior (Donner, 1990; Friedmann, 1988; Otsubo, 1988).

The five signal words compared in the present study were LETHAL, DANGER, WARNING, CAUTION, and NOTE. These particular terms were included because of their use in previous signal-word research (e.g., Leonard et al., 1986; Wogalter and Silver, 1990) or their inclusion in safety guidelines (American National Standards Institute, 1991; FMC Corporation, 1985; Westinghouse, 1981). Without a label or warning context, Wogalter and Silver (1990; Silver and Wogalter, 1991) found LETHAL to connote significantly greater hazard than DANGER, which in turn connoted greater hazard than WARNING or CAUTION (which did not differ). NOTE was perceived to carry the least connoted hazard. Given these findings, a similar pattern of results might be expected when the terms are presented in the context of product labels and warning messages.

Warning design standards and guidelines (American National Standards Institute, 1991; FMC Corporation, 1985; Westinghouse, 1981) also recommend that a signal icon (exhibiting an exclamation point surrounded by a triangle) accompany the signal word in warnings. The purpose of the signal icon is to gain attention and communicate the existence of a hazard. However, the influence of the signal icon has not received much

attention in the empirical literature except for recent work at Rice University. Young (1991) and Laughery, Young, Vaubel, and Brelsford (1993) found that search times to find warnings on simulated alcohol beverage labels were reduced when the signal icon was present as opposed to when it was absent. Although this research provides information on the signal icon's attention-getting properties, it does not address its capability to influence hazard perception. That is, it is possible that by increasing the likelihood that attention is attracted to the signal word and warning message, the signal icon also influences perceived hazard. In the present study, this possibility was explored by pairing the icon with two signal words, DANGER and LETHAL, and its influence was examined by comparing the ratings of labels with and without the signal icon.

In all of the signal-word conditions described earlier, the labels contained a brief product-related warning message. Two other conditions were included in the experiment. One lacked a signal word (but retained the associated warning message), and the other lacked both the signal word and the warning message. These two conditions were included to assess baseline hazard perception of the products and to determine the effect of the warning messages (without signal words) on perceived product hazard.

To summarize, given previous research, it was expected that (a) products with front labels lacking a warning message would be perceived as less hazardous than those with a warning message; (b) products with labels without a signal word would be perceived as less hazardous than labels with a signal word; (c) labels with the term NOTE would convey the least hazard of the signal-word conditions; (d) labels with the terms WARNING and CAUTION would not differ, but both would be perceived as less hazardous than labels with the term DANGER; (e) labels with LETHAL would be perceived to have the greatest level of hazard of the signal-word conditions; and (f) labels with the signal icon paired with the terms *lethal* and *danger* would increase the level of perceived hazard compared with the same labels without the signal icon.

METHOD

Participants

A total of 135 individuals participated. Three groups, each with 45 participants, were sampled: high school students from a public school in Troy, New York (ranging in age from 14 to 17), Rensselaer Polytechnic Institute undergraduates taking introductory psychology courses (ranging in age from 17 to 22), and individuals solicited at a major shopping mall in the Albany, New York area (ranging in age from 21 to 80, $M = 42.1$, $SD = 16.1$). As compensation for participating, the undergraduates received research credit, and the other two groups received a ballpoint pen or a $3 cash payment.

Materials and Stimuli

Sixteen brand-name consumer products were chosen to represent a range of hazard. The front labels were digitized using an optical scanner connected to a Macintosh computer with high-resolution graphics capability and were stored on disk. Using paint and draw software, we corrected defects from the scanning process. Signal words and accompanying warning messages were added using font sizes and styles that most closely matched the print on the original label. Black-and-white versions of the product labels were reproduced using a 300-dpi laser printer.

Of the 16 product labels, 9 served as carriers for the experimental conditions (aspirin, contact lens cleaner, drain opener, fabric protector, hair-styling mousse, paint thinner, pest-control fogger, plant food, and spray

adhesive). Also included in the set were seven "filler" labels of relatively safe products (bandages, bath soap, facial tissue, index cards, shampoo, toothpaste, and towelettes) that contained no signal word or warning message of any kind. The purpose of including the filler labels was to help preserve belief in the marketing study cover story by reducing the likelihood that participants would notice that the study was concerned with warnings.

All conditions except the no-warning/no-signal-word condition had a brief warning message on the front label (e.g., "Caustic Substance, Read Back Label"). When possible, the preexisting warning message from the original product was retained on the experimental labels. However, several of the original labels had the same or similar message on the front label (e.g., "Read Back Label"). To avoid redundancy among the labels, a few of the warning messages were modified (e.g., "Read Side Panel") or replaced with another message (e.g., from "Flammable" to one of the signal words). These modifications were adapted from the product's back-label warning or were constructed to describe a possible danger.

Of the nine experimental conditions, five involved the manipulation of the signal words: NOTE, CAUTION, WARNING, DANGER, and LETHAL. In two other conditions, the signal icon was placed above or to the left of the words DANGER and LETHAL. In the final two conditions, one lacked both the signal word and the associated warning message (no-warning/no-signal-word condition), and the other had a warning message but no signal word (no-signal-word condition). Figure 1 shows a fictitious product illustrating four of the nine experimental conditions.

Nine booklets were formed, each containing one label from each of the 16 products. The signal-word conditions were rotated through all experimental product labels according to a balanced Latin square to ensure that all experimental products appeared in every signal-word/warning condition. The seven filler product labels were randomly inserted into the booklets. A second balanced Latin square was used to order the product labels in the booklets.

A questionnaire was developed that requested responses based on nine-point Likert scales. The six questions together with the numerical and verbal anchors are shown below:

1. Frequency of use: "How frequently do you use this product?" The anchors were (0) *not at all*, (2) *infrequently*, (4) *frequently*, (6) *very frequently*, (8) *extremely frequently*.
2. Attention: "How likely is it that this product label would capture your attention if it were on a supermarket shelf?" The anchors were (0) *not at all likely to capture attention*, (2) *unlikely to capture attention*, (4) *likely to capture attention*, (6) *very likely to capture attention*, (8) *extremely likely to capture attention*.
3. Familiarity: "How familiar are you with this product (or a product of the same type)?" The anchors were (0) *not at all familiar*, (2) *slightly familiar*, (4) *familiar*, (6) *very familiar*, (8) *extremely familiar*.
4. Hazard: "How hazardous is this product?" The anchors were (0) *not at all hazardous*, (2) *slightly hazardous*, (4) *hazardous*, (6) *very hazardous*, (8) *extremely hazardous*.
5. Likelihood of purchase: "How likely are you to buy this product?" The anchors were (0) *not at all likely to buy*, (2) *unlikely to buy*, (4) *likely to buy*, (6) *very likely to buy*, (8) *extremely likely to buy*.
6. Expected cost: "How much do you think this product would cost?" For this question, participants were asked to write their best estimate of the price in the space provided on the answer sheet.

Only the fourth question was of particular interest. The other five questions were included to help disguise the true purpose of the study.

Procedure

Participants were first briefed and given a consent form to sign. Participants were told that the study was a marketing research survey dealing with people's perceptions of

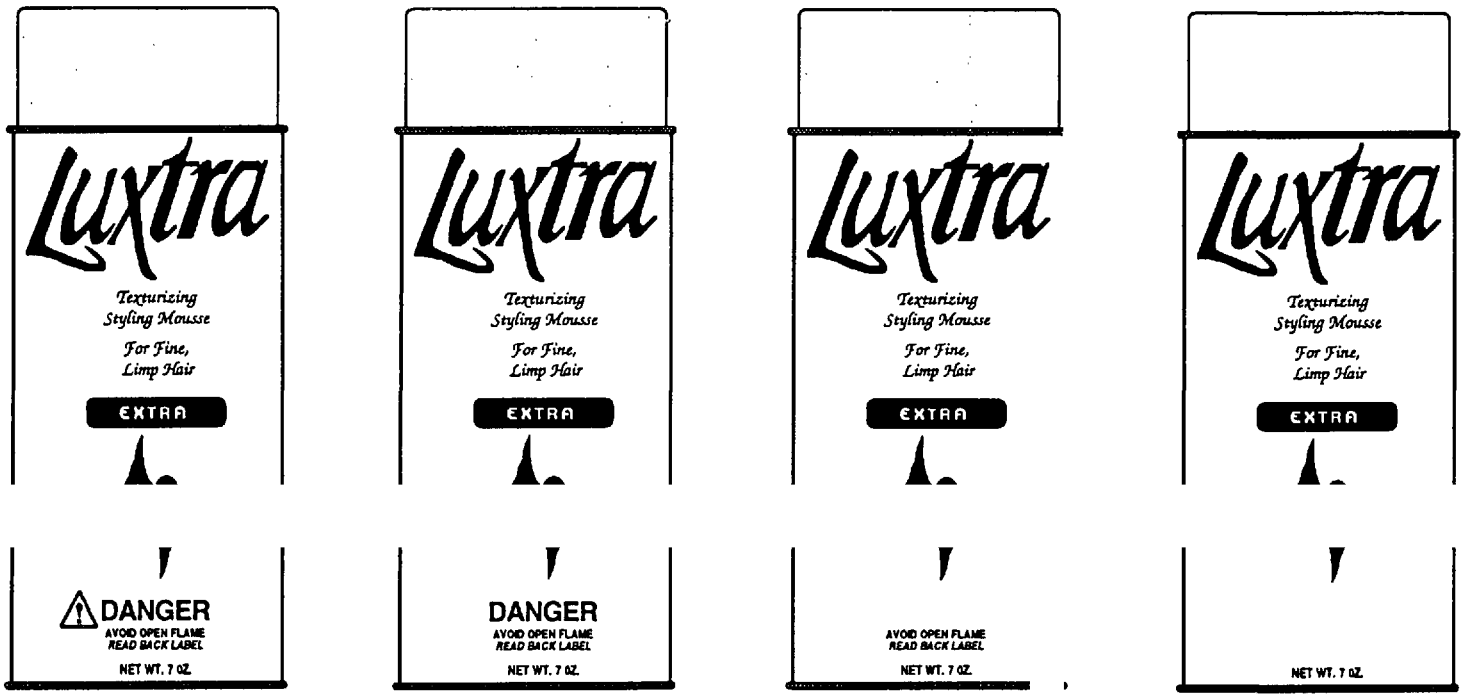

Figure 1. *Labels for a fictitious product illustrating four of the nine conditions. The labels differ on the presence of signal icon, signal word, and warning message.*

consumer products. Participants were given one of the nine product booklets and were asked to look through all of the labels. After this brief examination, participants were given the questionnaire and asked to rate the products in the order shown in their booklets on the six dimensions described earlier. Later, participants were fully debriefed as to the nature and purpose of the study and were compensated for their time.

RESULTS

The mean hazard ratings of the products carrying the experimental labels collapsed across all conditions ranged from 3.54 to 5.69. The mean hazard ratings of the experimental labels without a warning (i.e., the no-warning/no-signal-word condition) ranged from 2.40 to 5.87. These hazard values indicate that participants judged the products to be somewhat hazardous to very hazardous on the scale.

Table 1 shows the mean hazard ratings (and standard deviations) of the signal word/warning conditions for the three participant groups collapsed across products. Intercorrelations of the mean hazard ratings in this table showed strong positive relations among the participant groups, with rs ranging from 0.93 to 0.95, Ns = 9, and ps < 0.001.

A 3 (participant group) × 9 (signal word condition) mixed-model analysis of variance (ANOVA) on the hazard ratings showed significant main effects of participant group, $F(2,132) = 8.72$, $p < 0.001$, and signal-word condition, $F(8,1056) = 11.81$, $p < 0.0001$. There was no significant interaction of participant group and signal-word variables, $F(16,1056) < 1.0$, $p > 0.05$.

Comparisons among the participant group means using Fisher's Least Significant Difference Test showed that the high school students ($M = 5.29$) gave significantly higher ratings than the college students ($M = 4.77$), who in turn gave significantly higher ratings than the shopping mall participants ($M = 4.26$), ps < 0.05.

Comparisons among the signal-word means showed that the no-warning/no-signal-word condition produced significantly lower hazard ratings than all of the other conditions (ps < 0.05) except the no-signal-word and the NOTE conditions. The no-signal-word condition produced significantly lower hazard ratings than all of the conditions with

TABLE 1

Mean Hazard Ratings (and Standard Deviations) as a Function of Participant Group and Signal-Word Condition

	Participant Group			
Condition	*High School*	*College*	*Shopping Mall*	*Overall Mean*
No warning/no signal word	4.49 (2.88)	3.82 (2.44)	3.58 (2.16)	3.96
No signal word	4.42 (2.54)	3.53 (2.13)	3.49 (1.97)	3.81
NOTE	5.11 (2.46)	4.27 (2.22)	3.69 (2.37)	4.36
CAUTION	5.16 (2.52)	4.58 (2.15)	4.22 (2.22)	4.65
WARNING	5.36 (2.41)	4.62 (2.01)	4.58 (2.38)	4.85
DANGER	5.71 (2.34)	5.02 (1.73)	4.58 (2.75)	5.10
LETHAL	5.76 (2.48)	5.73 (2.25)	4.73 (2.78)	5.41
DANGER w/icon	5.69 (2.62)	5.13 (1.88)	4.42 (2.79)	5.08
LETHAL w/icon	5.96 (2.34)	6.18 (2.00)	5.07 (2.38)	5.73
Overall mean	5.29	4.77	4.26	

signal words. NOTE produced significantly lower hazard ratings than did DANGER and LETHAL, with or without the signal icon. Both CAUTION and WARNING produced significantly lower hazard ratings than did LETHAL, with or without the icon. Finally, the hazard ratings of DANGER, with or without the signal icon, were significantly lower than those for LETHAL with the icon.

Additional and more specific examination of the possible effect of the signal icon was investigated using only the comparable conditions with the icon present and absent (i.e., the four conditions with DANGER and LETHAL). A 3 (participant group) × 2 (presence vs. absence of icon) × 2 (DANGER vs. LETHAL) mixed-model ANOVA showed two significant effects. One was a main effect of participant group, $F(2,132) = 6.88$, $p < 0.01$. Comparisons among these means showed that the shopping mall participants (M = 4.70) gave significantly lower ratings than did either the college or high school students (Ms = 5.52 and 5.78, respectively). The two student groups did not differ. The other outcome of the ANOVA was a main effect of signal word, $F(1,132) = 5.90$, $p < 0.05$. Product labels having the term LETHAL (M = 5.57) received significantly higher hazard ratings than labels with the term DANGER (M = 5.09). No effect involving the signal icon (main effect or interaction) was found.

Finally, a series of 3 × 9 ANOVAs were conducted to explore whether the experimental conditions influenced the responses to the other five (nonhazard) questions. Significant effects were noted in two ANOVAs. In one, the capture-attention ratings showed a main effect of participant group, $F(2,132) = 9.76$, $p < 0.0001$, in which high school students (M = 2.04) reported that the labels were less likely to capture their attention than did college students (M = 3.01) or shopping mall participants (M = 2.90). In the other ANOVA, two effects were found using the price estimate scores. One was a significant main effect of participant group, $F(2,132) = 3.63$, $p < 0.05$, in which shopping mall participants (M = \$3.58) gave significantly lower estimates than the high school (M = \$4.09) or college (M = \$4.22) students. The other was a main effect of signal-word condition, $F(8,1056) = 2.34$, $p < 0.05$. Comparisons showed that labels with NOTE (M = \$4.20), WARNING (M = \$4.07), and DANGER with and without the signal icon (Ms = \$4.19 and \$4.08, respectively) were priced significantly higher than labels with no signal word (M = \$3.64) or CAUTION (M = \$3.67).

DISCUSSION

In general, the presence of signal words on product labels raised hazard perceptions. Though there were differences between extreme terms, there were no significant differences between the intermediate terms CAUTION, WARNING, and DANGER—the signal words recommended by most warning-design standards and guidelines (American National Standards Institutes, 1991; FMC Corporation, 1985; Westinghouse, 1981). This finding is consistent with results by Leonard et al. (1986), who reported no significant differences between the conventional signal words. Nevertheless, the ordering of the means concurs with the ordering defined by standards and the results of other research (Silver and Wogalter, 1991; Wogalter and Silver, 1990).

Perhaps we would have found significant differences between the intermediate terms (e.g., between CAUTION and DANGER) had we employed more participants and greater statistical power. Furthermore, if the experiment had included a group of participants who had been systematically trained on the terms' meanings or extensively exposed to the appropriately assigned terms on a range of hazardous products, then the experiment might have been better able to show greater

discrimination between terms. Although this and other kinds of training would probably be of some benefit given their current usage in warnings, its necessity could have been reduced had the terms been well chosen in the first place. For example, most research shows that the general English-speaking public does not distinguish between the terms WARNING and CAUTION on connoted hazard, even though the recently released ANSI (1991) standard defines and professes a difference. Rather than assigning arbitrary distinctions between terms of similar meanings and then expecting people to come to know the underlying definitions (as is the case with the current standards), a better procedure would involve basing the selection of terms on their extant meaning to the target population. The only appropriate way to do this is to base the selection on empirical data from those groups. Such data-based selection approaches would obviate the need for costly training programs and would avoid the common problem of not being able to educate all of the relevant individuals at risk, such as many ordinary consumers.

No effect of signal icon was shown. Though the means show a positive trend when the icon was added to the term LETHAL (producing the highest hazard ratings in the experiment), there was no such trend when it was added to the term DANGER. Apparently, the signal icon's main utility is to attract people's attention to the warning (Laughery et al., 1993; Young, 1991), but it has little or no additional influence beyond this (such as affecting hazard perception). However, additional research is necessary to confirm this assertion. Under conditions somewhat different from those of the present experiment, such as complete crossing of the icon variable with signal words connoting less hazard, a more discernible pattern of results might be shown.

It had been expected that the labels without a warning (no-warning/no-signal-word condition) would be perceived to be less hazardous than labels simply lacking a signal word (no-signal-word condition). This expectation arises from the fact that no hazard is explicitly described in the first case. However, no significant difference was found in the present experiment, and interestingly, the means show a trend in the opposite direction. Although further investigation is needed to determine this pattern's reliability, this trend might be related to an effect reported by Ursic (1984) and noted in additional research (Laughery and Stanush, 1989; Leonard, Ponsi, Silver, and Wogalter, 1989; Silver, Leonard, Ponsi, and Wogalter, 1991). These studies suggest that products with no warning on the label produce uncertainty in the minds of consumers as to their degree of safeness. The implication is that without a warning, consumers may feel unsure of the product's potential hazards, thus raising in their minds the possibility that there might be hazards that they do not know about. This line of reasoning suggests that having a warning may assure people (by conveying or reinstating the notion) that they know or could know the hazards associated with the product.

Results showed that the hazard ratings to the signal-word conditions were significantly higher for the younger participants. This result concurs with the findings of Silver and Wogalter (1991) that younger individuals (elementary- and middle-school children) tend to give higher hazard ratings to signal words than do older individuals (college students). Silver and Wogalter (1991) speculated that the age difference might be the result of older individuals' more frequent past exposures to warning labels and signs, producing a kind of habituation resulting from numerous benign experiences. This effect is similar to the familiarity effect shown in previous warning research (Godfrey et al., 1983; Godfrey and Laughery, 1984; Wogalter et al., 1991). However, this explanation is not in accord with

the failure in the present experiment to find group differences with respect to product familiarity or frequency of use. Rather, the age effect may be associated to perceived severity of consequences. Wogalter et al. (1991) found belief in severe outcomes to be a major factor in product hazard perceptions. Thus the younger participants (more than the older participants) might have believed that there were greater negative consequences from using the products (not only from being injured but also from being admonished by authority figures such as parents and teachers), thus raising their hazard ratings. However, this explanation is not without some problems, as other research indicates that younger individuals tend to believe that they are less vulnerable to physical injury. Additional research is needed to determine whether mediator variables such as perceived consequences influence different groups of people with respect to hazard-level perceptions.

Another observation regarding the participant samples is noteworthy. This experiment included not only the usual sample of undergraduates but also a sample of students from a public high school and individuals in a shopping mall. The consistent ordering of conditions among these three populations (as shown by correlations and the failure to find an interaction with the experimental conditions) supports earlier work showing similar connotations across different populations (e.g., Dunlap et al., 1986; Silver and Wogalter, 1991). The consistent pattern among the different participant samples also suggests that the results may be generalizable to other groups.

Examination of the data for the other five questions yielded only a few effects. In one, the high school students rated the labels as less likely to capture their attention than did either the college students or the shopping mall participants. In another, the shopping mall participants gave lower price estimates than did either of the student groups. Also, labels with *note, warning,* and *danger* (with and without the signal icon) were given significantly higher price estimates than labels with no signal word or *caution.* Solid explanations for these results are not easily forthcoming, but some tentative interpretations can be offered for two of the effects. Possibly the high school students rated the labels as less attention-getting because generally they do not purchase household goods. Alternatively, high schoolers may be so accustomed to highly salient messages (e.g., on television and in magazines) that other kinds of salient messages, such as product labels, are less likely to capture their attention. In addition, the shopping mall participants possibly gave lower price estimates because they were more likely to be regular shoppers and would tend to know "good" prices. However, the effect of signal word on the price estimates is much less interpretable. It is not clear why the signal-word conditions would influence judged price and not some of the other evaluated dimensions, particularly the item on purchase likelihood. In any case, these effects may be attributable to chance and seem to require confirmation by other research before elaborate explanations are warranted.

Finally, the present research adds to our knowledge of signal words, showing that signal words are capable of changing people's perceptions of product hazard. In addition to the study's basic findings, however, the research methodology makes three advances in this area. First, the research employed procedures to disguise the true purpose of the research (under the guise of a marketing research study), so that indirect and more realistic influences of the signal words could be measured. Second, participants were exposed to signal words in the context of warning messages on product labels, providing greater external and face validity than previous research in this area. Third, the method

of constructing the stimuli (e.g., computer digitization and manipulation of labels) holds promise for other investigations on the effects of warnings and label variables (e.g., on message content and format).

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