

Pest-control Products: Hazard Perception, Product Type and Label Characteristics

N. Clayton Silver and Michael S. Wogalter

N. Clayton Silver is an assistant professor of psychology at the University of Central Florida. He received a B.A. from the University of Cincinnati, and M.S. and Ph.D. degrees from Tulane University. Before joining the faculty of UCF, he held faculty appointments at the University of Richmond and Appalachian State University. His current areas of research include statistics, computer applications, warnings, and racial differences in self perception. He is a member of the Southeastern Psychological Association, Southwestern Psychological Association, and Sigma Xi. Address: Department of Psychology, 322 Phillips Hall, University of Central Florida, Orlando, Florida 32816.

Michael S. Wogalter is an assistant professor of psychology at Rensselaer Polytechnic Institute. He received a B.A. from the University of Virginia, an M.A. from the University of South Florida, and a Ph.D. from Rice University. Before coming to RPI, he held a faculty appointment at the University of Richmond. His principal research interests include safety issues, warnings, hazard perception, and human memory. Mike holds memberships in several professional organizations including: Human Factors Society, American Psychological Association, American Psychological Society, Psychonomic Society, Eastern Psychological Association, American Association of University Professors, and Sigma Xi. Address: Department of Psychology, Carnegie Hall, Rensselaer Polytechnic Institute, Troy, NY 12180-3590.

ABSTRACT

We investigated variables related to people's perceptions of hazard for various types of household pest-control products. Seventy college-aged students, 20 older subjects, and four pesticide experts judged 26 pest-control products on hazard. Results showed that fumigators and foggers were perceived as the most hazardous followed by sprays, systems, and traps, respectively. Although several misperceptions of hazard for certain product categories were evident, the judgments of the students and older adults were consistent with those of the experts. Perceived hazard was also found to be positively correlated with a number of objective characteristics of the product labels, including the quantity of chemical ingredients, pests effective against, number of words and sentences on the label, readability, and the presence and location of certain statements on the back label. These findings suggest that people can discriminate the hazard levels of different types of pest-control products, and the presence of various cues on the label may aid in this determination.

INTRODUCTION

In 1988, the U.S. Consumer Product Safety Commission (CPSC) estimated that over 14,000

people are admitted to U.S. hospital emergency rooms yearly for pesticide product-related injuries. Although only 11.7% of the individuals suffering from these injuries were hospitalized, the number of injuries involving these products suggests that people are not fully aware of the hazards and misuses.

Many people may not know the dangers, because most modern pesticides in the consumer marketplace involve recent developments and new technologies. One primary method that manufacturer's use to communicate hazard information to consumers is through product-label warnings. The number of injuries cited by the CPSC is particularly disturbing because most pest-control products contain warnings. The CPSC data suggest that people are not reading the warnings (or at least not acquiring the appropriate information from them).

Warnings may not be read for a host of reasons. Some of the reasons include: a failure of the warnings to attract people's attention (Wogalter, Godfrey, Fontennelle, Desaulniers, Rothstein, & Laughery, 1987; Young & Wogalter, 1991), familiarity with the product (Godfrey, Allender, Laughery, & Smith, 1983), and vicariously seeing the product used without incident (Wogalter, Allison, & McKenna, 1989). Additional

variables that have been studied can be found in DeJoy (1989) and Miller, Lehto, & Frantz (1990).

Recent research by Wogalter, Brelsford, Desaulniers, and Laughery (1991) shows that perceived hazard is an important predictor of people's willingness to read warnings on various consumer products. In addition, Silver, Leonard, Ponsi, and Wogalter (1991) have recently reported that people are more willing to read warnings on more hazardous pest-control products.

The purpose of the current research was to continue to explore the factors related to perceptions of hazard for common household pest-control products. In this report, we examined the cues people might use to determine perceptions of hazard for pest-control products. In particular, we investigated (a) whether people's hazard perceptions depend on the type of the product and the population of subjects making the judgments and (b) whether hazard perceptions relate to the various characteristics of printed labels and warnings on these products.

METHOD

Subjects

Seventy undergraduate students from an introductory psychology course at the University of Richmond participated for class credit. A second group of 20 adults with a mean age of 37 years were paid for their participation. In addition, four pesticide experts evaluated the products on hazard. Two were administrators in different pest-control organizations, the third was employed by the Virginia Department of Agriculture and Consumer Services' Office of Pesticide Regulation, and the fourth expert was employed at the Virginia Department of Health's Toxic Substance Information Department.

Materials and procedure

Twenty-six pest-control products claiming to control roach problems were obtained from hardware, drug, and grocery stores in the Richmond, Virginia area. Five types of products were represented: four traps, four systems, eight sprays, eight foggers, and two fumigators. Each product within a given product type were from different manufacturers. Flying-insect sprays and agricultural pesticides were not included in the sample of products.

A product perception questionnaire was used to assess various perceptions of the products' packaging, labeling, and warnings. One of the questions asked: "How hazardous do you think the product is?" The numerical and verbal anchors were: (0) not at all hazardous, (2) somewhat hazardous, (4) hazardous, (6) very hazardous, and (8) extremely hazardous. Other questions and additional aspects of the rating procedure can be found in Silver et al. (1991).

Over 100 objective characteristics of the product labels were coded. The characteristics assessed included: the products' chemical contents (e.g., percentages of active and inert ingredients), duration of effectiveness, the number and kind of pests effective against, the presence of a list of symptoms, poison hot-line information, whether it was a danger to pets, the kind of packaging, and the characteristics of label and warning information (e.g., location on package, text formatting, size, and color).

Product perception procedure

Participants were run in groups of three to eight. The pest-control products were placed on tables in a large room with numbered identification placards next to each product. Participants were given the product perception questionnaire containing the question on product hazard, and a booklet of randomly-ordered response forms. Participants were told that each response form was numbered to correspond to one of the products in the room, that each of the products was to be examined in the order indicated by the response form packet, and that the questionnaire was to be completed for each product before going on to the next one. Participants were allowed to handle the products, but for safety reasons, the nozzles of all aerosol products were removed.

RESULTS

Product type

A 5 (product type) X 3 (subject group) mixed-model analysis of variance (ANOVA) was performed using mean hazard rating as the dependent variable. The hazard ratings were collapsed across subjects within each group (students, older adults, and experts) to form means for each product. Table 1 shows the mean hazard ratings

Table 1

Perceived Hazard Mean as a Function of Product Type and Subject Group.

	Students	Older Ss	Experts
	mean SD	mean SD	mean SD
Fumigators	4.16 .09	4.42 .09	4.38 .12
Foggers	3.91 .26	4.21 .56	4.62 .62
Sprays	3.68 .14	3.87 .23	3.81 .40
Systems	2.84 .12	3.24 .33	2.19 .64
Traps	1.64 .17	1.73 .38	0.31 .53

as a function of product type for the three groups of subjects.

The ANOVA showed a significant main effect of product type, $F(4, 21) = 151.68, p < .0001$. Subsequent Newman-Keuls range tests indicated that all product types differed from each other in perceived hazard ($ps < .0001$), except for the difference between fumigators and foggers. The order of product types from greatest to least in perceived hazard was fumigators, foggers, sprays, systems, and traps, respectively. There was also a significant main effect of subject group, $F(2, 42) = 7.05, p < .01$. Subsequent Newman-Keuls tests indicated that the older subjects gave significantly higher ratings of hazard than the younger and expert subjects ($ps < .05$) with the latter two not differing significantly ($p > .05$).

A significant interaction was also present, $F(8, 42) = 6.29, p < .0001$, as illustrated in Figure 1. Simple effects analyses showed significant differences among product types for each of the three subject groups ($ps < .0001$). For the younger subjects, subsequent tests indicated that all differences between the product types were significant ($ps < .05$). For the older subjects, subsequent Newman-Keuls tests indicated that whereas fumigators, foggers, and sprays did

not differ significantly among themselves ($ps > .05$), all three were perceived as more hazardous than systems and traps ($ps < .05$). In addition, systems were perceived as more hazardous than traps ($p < .05$). For the expert subjects, the subsequent tests showed the same pattern of significant differences as the older subjects. As can be seen in Table 1, the experts considered the fumigators to be slightly more hazardous than foggers, but the Newman-Keuls test failed to show this difference as significant ($p > .05$).

Simple effects analyses also indicated significant effects of subject group for foggers, systems, and traps ($ps < .05$), but no effect of subject group for sprays and fumigators ($ps > .05$). Subsequent Newman-Keuls tests indicated that the students perceived the foggers as less hazardous than did the experts ($p < .05$). The older subjects' hazard ratings of the foggers were intermediate and did not differ from the other two groups ($ps > .05$). For the systems, the older subjects ratings were significantly higher than the experts ($p < .05$). The younger subjects' rating of the systems was intermediate and did not differ from the other two groups ($ps > .05$). For the traps, the younger and older subjects did not differ ($p > .05$), but both groups rated them to be significantly more hazardous than the experts ($ps < .05$).

Label characteristics with perceived hazard

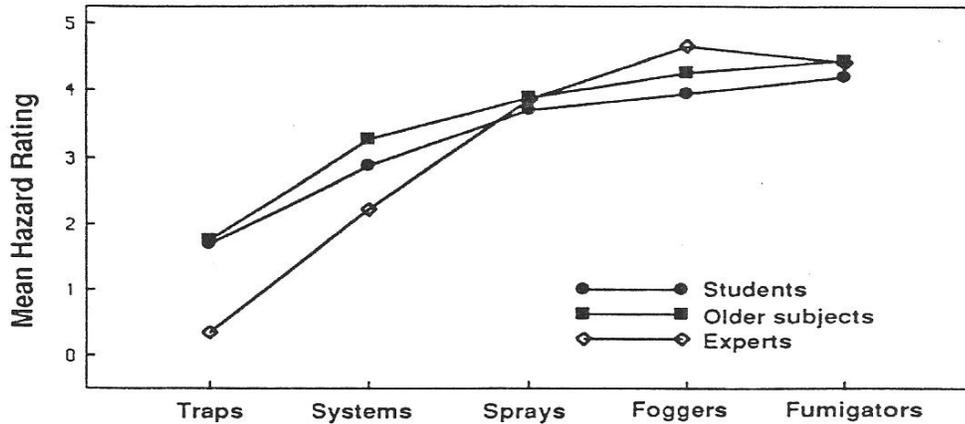
In the following analyses, the objective characteristics of the label were correlated to the hazard perception ratings. Intercorrelational analysis of the hazard ratings showed a high degree of reliability among the three groups (rs ranging from .89 to .94). Thus for ease of exposition, only the hazard data of the student subjects are used in the following analyses. Because over 100 objective characteristics were measured, a more stringent alpha level of .001 was used as the cutoff for significance.

Chemical contents & effectiveness. Greater perceived hazard was associated with products having greater numbers of chemical ingredients, $r = .66$, shorter durations of effectiveness, $r = -.92$, and greater number of pests claimed to be effective against, $r = .67$ ($ps < .001$).

Front-panel warning. Greater perceived

Figure 1

Perceived Hazard Mean as a Function of Product Type and Subject Group:



hazard was associated with products having statements on the front panel directing consumers to keep the product out of the reach of children, $r_{po} = .88$, and to see the back panel for additional information, $r_{po} = .90$ ($ps < .0001$).

Back/side panel warning. Greater perceived hazard was associated with presence of separate warning sections describing storage and disposal procedures, $r_{po} = .88$, practical treatments in case of exposure/injury, $r_{po} = .89$, and the potential for physical damage from product misuse, $r_{po} = .77$ ($ps < .0001$). Greater perceived hazard was also associated with the location of directions and warnings. The closer to the top (rear side) of the container were the directions for use, $r = -.74$, warnings of personal injury, $r = -.68$, physical damage, $r = -.70$, and practical treatment, $r = -.66$, the more hazardous the product was perceived to be ($ps < .001$).

Also, greater hazard was associated with the need to seek medical attention if exposed, $r_{po} = .63$, and danger to pets, $r_{po} = .77$ ($ps < .001$). Greater product hazard was also associated with the presence of statements indicating flammability, $r_{po} = .65$, contents under extreme pressure, $r_{po} = .76$, and to keep away from high heat, $r_{po} = .69$ ($ps < .001$).

Readability. Greater hazard was associated with greater number of words, $r = .65$, and sentences, $r = .74$, on the back label ($ps < .001$). Greater hazard was also associated with higher levels of reading skill (Flesch grade-level index as modified by Gray, 1975) necessary to understand the printed material, $r = .74$ ($p < .0001$).

DISCUSSION

Results showed that fumigators and foggers were perceived as the most hazardous pest-control products followed by sprays, systems, and traps, respectively. In general, the ratings of hazard by the students and older adults were consistent with those of the experts. However, some exceptions were noted. The students and older adults tended to overestimate the hazard of the traps; the older adults overestimated the hazard of the systems; and the students underestimated the hazards of the foggers.

Why misestimations were found is not particularly clear. One explanation is that the novice subjects (students and older adults) might have been unaware that household roach traps and systems do not contain pesticides and are a reasonably safe means of controlling roach problems (cf. the expert judgments). The novice sub-

jects might have generalized the hazard of the pesticide-containing products to pest-control products that had no pesticide. If so, it suggests that people are not fully aware that much less hazardous pest-control products are available that may be adequate for their purposes and pest problems. Alternatively, the overestimation of hazard of traps and systems might be due to rating error. That is, the experts might have had more experience with rating scales and felt more comfortable with making ratings on the lower extremes of the scale than the novices. The underestimation of the foggers by the students is not easily explained as they did not exhibit this effect for any other product type. Further investigation will be needed to determine whether the misestimations can be replicated

Perceived hazard was also positively correlated with a number of objective characteristics of the product labels including the number of chemical ingredients, the number of pests effective against, particular statements such as "Keep out of reach of children", placement of certain label and warning components, the number of words and sentences, and low readability scores, among others. These cues may aid people in determining the potential hazard of a pest-control product. One implication is that the marketing of a dangerous pest-control product without such cues might contribute to a misperception hazard, and as a possible consequence, could lead to improper use or misuse of the product (Wogalter et al., 1991). By extension, this implication would suggest that manufacturers should not make label changes to their hazardous products. However, the problem is probably much more complex than this simple interpretation. For example, most warning design experts would advocate improvements in label readability. If difficulty in reading the label serves as a cue that the product is hazardous, as was suggested in the current study, an easier to read label might indicate that the product is safer than it really is. However, many potential label cues exist on pest-control product labels and a change to one, e.g., the label's readability, will probably not substantially influence perceptions of hazard by itself. Indeed, by making the label more readable, it has the potential to better communicate the hazard level than one that is less readable. Clearly, further research is necessary to determine the relative importance of label cues as they relate to perceptions of hazard.

REFERENCES

- DeJoy, D. M. (1989). Consumer product warnings: Review and analysis of effectiveness research. In *Proceedings of the Human Factors Society 33rd Annual Meeting* (pp. 936-940). Santa Monica, CA: Human Factors Society.
- Gray, W. B. (1975). *How to measure readability*. Philadelphia: Dorrance & Co.
- Godfrey, S. S., Allender, L., Laughery, K. R., & Smith, V. L. (1983). Warning messages: will the consumer bother to look? In *Proceedings of the Human Factors Society 27th Annual Meeting* (pp. 950-954). Santa Monica, CA: Human Factors Society.
- Miller, J. M., Lehto, M. R., & Frantz, J. P. (1990). *Warnings & Instructions: The annotated bibliography*. Ann Arbor, MI: Fuller Technical Publications.
- Silver, N. C., Leonard, D. C., Ponsi, K. A., & Wogalter, M. S. (1991). Warnings and purchase intentions for pest-control products. *Forensic Reports*, 4, 17-33.
- Wogalter, M. S., Allison, S. T., & McKenna, N. A. (1989). The effects of cost and social influence on warning compliance. *Human Factors*, 31, 133-140.
- Wogalter, M. S., Brelsford, J. W., Desaulniers, D. R., & Laughery, K. R. (1991). Consumer product warnings: The role of hazard perception. *Journal of Safety Research*, in press.
- Wogalter, M. S., Godfrey, S. S., Fontenelle, G. A., Desaulniers, D. R., Rothstein, P., & Laughery, K. R. (1987). Effectiveness of warnings. *Human Factors*, 29, 599-612.
- Young, S. L., & Wogalter, M. S. (1990). Comprehension and memory of instruction manual warnings: Conspicuous print and pictorial icons. *Human Factors*, 32, 637-649.