PROCEEDINGS of the HUMAN FACTORS SOCIETY - 22nd ANNUAL MEETING - 1978

HUMAN FACTORS IN THE DESIGN OF EFFECTIVE PRODUCT WARNINGS

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Warning messages for product use are important for the safety of the user and to fulfill the legal duty to warn on the part of the manufacturer. A number of issues related to the design of such warnings have been neglected by human factors specialists. The studies that have been done have been primarily for private companies or in conjunction with litigation after an accident has occurred. Thus, little is available in the open literature.

This paper points out some related behavioral work which has been published and outlines the problems associated with designing effective product warnings. Suggestions are made for further research.

INTRODUCTION

Each year many people receive injuries which are associated with their use of products at home, at work or in recreation. There is no way of knowing whether the injury rate has increased over the years, but there is no question that public awareness of these injuries has increased dramatically. This is in no small part due to the advent of the Consumer Product Safety Commission (CPSC) which has highlighted the problem both by publishing data on product related injuries and by the continuing controversy which has surrounded the Commission itself.

A related phenomenon which has done much to publicize product safety issues is the rather dramatic increase in products liability lawsuits and the large and well-publicized awards which sometimes result. This, in turn, can be attributed in large part to the coming of age of the legal doctrine of strict liability. It should be noted that while it is common to speak of "consumer product safety", in fact, a large number of products liability suits involve products which do not fall within the jurisdiction of CPSC.

While human factors specialists have become heavily involved in product safety as consultants, expert witnesses and product safety specialists in industry, surprisingly little in the way of basic and applied research in the area has appeared in the open literature. As a result, much of the input of human factors analysts to product safety issues has consisted of application of the basic principles of human factors engineering without the benefit of techniques and data bases which are specifically tailored for the problems at hand. It is the purpose of this paper to outline a particular group of problems related to product safety which are susceptible to human factors analysis.

WARNINGS AND BEHAVIOR

The producer of a product has both moral and legal obligations to warn of possible dangers associated with use of the product. Any product is capable of producing injury under given circumstances. The conditions which may lead to injury are dependent upon the physical design of the product and the behavior of the user. The human factors discipline can make little meaningful contribution to product design without an understanding of how the user will behave. The purpose of a product warning, as typified by a label or decal, is to induce certain patterns of behavior and discourage or eliminate other actions.

The practical problem of producing a safe product, then, is one of developing a design which minimizes the possibility of injury and warning the user regarding those courses of behavior which may lead to injury. The issue is complicated by the fact that the manufacturer is legally obligated to produce a product which is not only safe under normal use but also under foreseeable misuse. This means that there is a wide array of behavior which the manufacturer would like to discourage or prevent.

Aside from legal requirements, warnings would be unnecessary if people were proficient at assessing hazards. Unfortunately, the available evidence strongly suggests that this is not a human strong point. For example, Lichtenstein, Slovic, Fischoff, Layman and Combs (1978) have reported a series of studies which examined the ability of persons to judge frequencies of death associated with various causes. They found a

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consistent tendency to underestimate high frequencies and overestimate low ones. Furthermore, they found other biases which may be associated with the publicity or exposure provided to certain causes. Fischoff (1978) has discussed this and related findings in some detail.

In another recent experiment, Dorris and Tabrizi (1978) compared ratings of perceived level of hazardousness associated with familiar products with injury frequencies reported by CPSC. It was found that even though hazardousness ratings were rather reliably estimated, mean hazard ratings did not correlate significantly with objective frequencies.

If, as the evidence suggests, humans are poorly equipped to identify hazards, there remains the question of to what extent behaviors are modified by warnings. Although there is a dearth of direct evidence in the literature, the information which is available is not encouraging. Everyday experience and carefully conducted field studies alike indicate that buzzer-lights, interlock systems and televised public service messages are all ineffective means of inducing seal belt usage among automobile drivers. Similarly, fear appeals (Sternthal and Craig, 1974) have been shown to result in inconsistent and in some cases negative results.

Perhaps the area of behavioral research which has most clearly pointed out the general reluctance of human beings to heed warnings has been the study of responses to the threat of natural disaster. It seems clear that in a number of well documented cases, the public received specific warnings regarding floods, tornadoes or tidal waves and yet substantial numbers of people lost their lives because they chose to take no evasive or mitigating action. Fritz (1961) and Mileti (1975) discuss the problems associated with natural hazards warning systems.

CHARACTERISTICS OF EFFECTIVE PRODUCT WARNINGS

Past experience suggests a number of product warning issues which must be considered to be basic to effective communication. Some of these issues are discussed in this section.

Duty to Warn

The first issue which must be addressed is that of deciding which possibilities for injury require a warning. In many ways this is the most difficult problem in that the possibilities are virtually limitless. The legal requirements vary greatly from one court to another, but in general one must warn about substantial dangers which are associated with normal use or foreseeable misuse. In a recent case (Bookovt v. Victor Comptometer Corp., Colo. Ct. App., March 2, 1978) it was ruled that an individual who lost an eye in an accident involving a BB gun could not recover since the potential danger was apparent. A Louisiana court ruled that an individual who injured an eye when the head of a hammer chipped could not recover since the head had been previously chipped and the individual continued to use it. (Chappvis v. Sears, Roebuck and Co., La. Ct. App., July 11, 1977). This finding was reversed by the Louisiana Supreme Court who found that it was reasonable to require a warning that the hammer should not be used when chipped (Chappvis v. Sears, Roebuck and Co., La. Sup. Ct.).

Warnings Versus Instructions

It has been clearly established that in the eyes of the court, a warning must be something more than an instruction. A warning will indicate a potential hazard or danger and will specify the proper action of the product user. On large pieces of equipment, it is important to distinguish between warnings and operating instructions which may appear on the machine. This is most effectively handled by standardizing the format, colors and symbols which are used for warning signs and using dissimilar configurations for instructional messages. Conformance with standards generated by professional or industrial associations such as SAE, ASAE or ASME or with ANSI specifications may provide guidance.

Understandability

A warning message which is not completely comprehended is obviously not totally effective. The most common problems in this regard are the use of vague, ambiguous or ill-defined terms, the use of highly technical words or phrases or the use of long or gramatically complex phrasing. For verbal messages, the language in which it is written may be of concern if the product is distributed internationally or used in areas of this country which have sizable groups of non-English speaking citizens. If symbolic messages are employed, one must be sure that the symbols are readily understood by the population of users.

It is also true that the warning must adequately reflect the degree of danger associated with that particular hazard. Signal words such as "Danger", "Caution" or "Warning" may be employed but one must be sure that the degree of hazardousness implied by each work is understood by the product user.

Durability

The warning sign, label or decal must be manufactured and attached in such a manner as to remain for the life of the product. This is of particular importance for products that are subjected to extreme use or weathering. A product which is subject to having parts replaced or is

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likely to be re-painted must be carefully monitored to ensure that the warning is not removed or obliterated.

NEEDED HUMAN FACTORS RESEARCH

The problem of designing effective product warnings is one which could profitably be undertaken by human factors specialists. To date, far more effort has been devoted to the study of a warning (or lack of warning) as a part of the litigation process subsequent to an accident than has been devoted to the development of design criteria for warnings. Although the physical layout of the message and the design of alphanumeric characters is well studied by human factors analysts, many of the key issues remain matters of opinion. In this section, some issues which are greatly in need of input are discussed. Additional discussion may be found in Dorris and Purswell (1977).

The optimal amount of warning information to be presented is a topic of vital concern. This includes a consideration of the length, specificity and degree of detail associated with a warning and, more importantly, the number of warnings which can be effective on a given product. It would seem likely that an individual is less likely to read many warnings than a few. Marketing specialists have devoted considerable effort to determining the proper balance between too much and too little label or other information in terms of inducing the consumer to purchase the product. Certainly, similar research aimed at inducing the consumer to use the product safely would be of decided benefit.

Various warning specifications have used colors, signal words and symbols to attract the attention of the user and convey the degree of hazard associated with the particular problem at hand. Bresnahan and Bryk (1975) have investigated accident prevention signs based upon ANSI Z35.1-1968, Specifications for Accident Prevention Signs (since revised), to determine the "hazard association values" of these signs. This type of study must be encouraged and extended to include a wide variety of warning signs.

Symbolic warnings are gaining in popularity as a means of communicating with those who would not understand written messages such as the illiterate, the retarded, the pre-literate or those who speak a different language. It might also be conjectured that symbolic warnings may be recognized more rapidly, have more intrinsic interest than written warnings and may be more effective by graphically depicting the possible injury and thereby generating increased emotional response. Most studies of symbolic messages have considered whether or not people can understand the message. A more important question is "Given that written and symbolic messages can both be understood, which are more effective at inducing people to act in accordance with the warning?"

The most serious obstacle to the investigation of product safety issues is the lack of suitable methodology. Many products are used in privacy or in remote areas so that the behavior of the user is very difficult to study. It is difficult to study people drying their hair in their own home or farmers driving their tractors in remote fields. It is also not clear that studying behavior in contrived or experimental settings will produce valed findings.

A final area which would appear to be of interest is an investigation of those pschological and background factors which affect the response of an individual to a warning. Research into responses to natural hazards warnings have found that if an individual receives numerous warnings without an incident taking place, the likelihood of responding to subsequent warnings is lessened. On the other hand, prior personal contact with a given type of hazard may well increase the liklihood of response. A similar phenomenon may well exist with regard to product warnings. Such personal variables as age, sex, familiarity with the product, risk attitudes and other factors may well correlate with responses to product warnings. The studies by Schneider (1977), Martin and Heimstra (1973) and Tokuhata, Colflesh, Smith, Ramaswamy and Digon (1976) serve as examples of investigations of the behaveral factors which influence safe behavior.

SUMMARY

Although the design of effective product warnings is an issue of considerable social and practical interest, the human factors discipline has been slow to initiate research in this area. At least two factors would seem to be primary causes for this lack of activity. In the first place, there is little large-scale federal funding of basic product safety research from a behavioral perspective. Academic researchers, under constant pressure to obtain funding, are unlikely to undertake such projects unless research funds are available. There is considerably more incentive to undertake individual projects on a consulting basis with the results, of course, being kept confidential.

A second factor which mitigates against the appearance of more behaviorally oriented product safety research studies is that the behavioral problems encountered involve elusive and subtle phenomena which do no readily lend themselves to analysis by way of factorial designs and ANOVA. One cannot avoid considerations of attitudinal and motivational factors which have tradionally been ignored by human factors researchers. Until the bias that such "soft" issues are not within the scope of human factors research has been overcome and new methodologies for dealing with these concepts have been adopted, significant research into how people use products at work and at home and how to best warn them of.

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the potential for injury will not be accomplished.

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