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Receiver Characteristics in Safety Communications

Stephen L. Young
Liberty Mutual Research Center for Safety & Health

Kenneth R. Laughery
Rice University

Michael S. Wogalter
North Carolina State University

David R. Lovvoll
Rice University

39.1 Introduction

An interesting aspect of the warning process occurs when people pick up a prescription drug at a pharmacy. In many cases, these medications are accompanied by a patient package insert (PPI). PPIs contain detailed information about the nature of a drug, potential side effects, prescriptions and proscriptions for use, and a wealth of other details about the chemical makeup of the drug. PPIs are similar in scope and detail to the information contained in drug reference books (e.g., *Physician's Desk Reference*). One look at these documents will tell you that they are not designed for the layperson, but rather they are designed to provide the kinds of information and the level of detail that would primarily benefit an individual with substantial medical training. Because of the level of sophistication required to acquire relevant information from PPIs, pharmacies will often provide a briefer and simpler summary of the relevant information for use by the lay customer. The purpose of the summary is to provide the end user with the most important information necessary to use the drug properly.

While a central tenet of warning theory is that it is important to provide people with information so they can make informed choices regarding their behavior, it is not necessarily true that more information is better. Table 39.1 shows the information provided in a PPI and in a pharmacy summary for the same drug. It is clear that the information is targeted for two different audiences. Physicians are provided detailed information, because they need it to make proper prescribing decisions. However, patients (for the most part) will not find much of the detail helpful, and they could find it difficult and confusing. It may actually make the extraction of relevant information *more* difficult.

This example demonstrates, in a very basic way, that one must consider who is the audience when designing, producing, and delivering safety-related information. Other examples might include the presentation of information in material safety data sheets (MSDSs) and in OSHA regulations.

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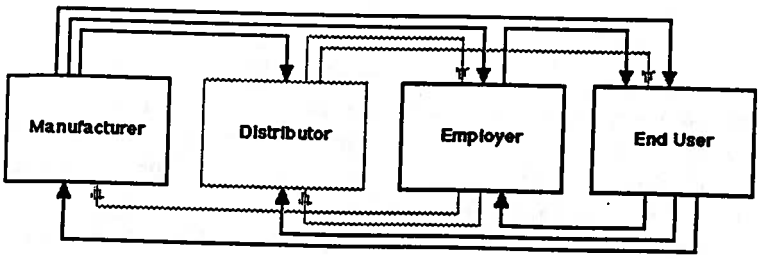

FIGURE 39.2 Complex warning communication system.

The sender, or source, represents the originator of the communication. With respect to warnings, the message is the relevant information that is to be transmitted via some medium. The message could (and preferably would) contain information about the nature of the hazard, consequences of exposure to the hazard, and/or instructions on how to avoid the hazard. The medium refers to the channel or route by which information moves from the source to the receiver. Media for warnings can include MSDSs, on-product labels, package inserts, signs, oral instructions, and so forth. The receiver refers to any and all persons who are at risk and to whom the warning should be directed. Characteristics of each of these components may, and often do, play a critical role in the effectiveness of a warning.

In the most simple application of this model to the warning process, a manufacturer of a product (the source) attempts to relay some warning message using one or more media to an end user of the product (the receiver). However, the process of conveying warning information is not always so straightforward. For example, Figure 39.2 represents the elements of a more complex warning communication system for a product being used in an industrial setting. Here the product might be marketed through a distributor (or a series of distributors) to an employer (the business and its management) who in turn communicates in various ways with the end user (employee). Communication from the manufacturer to the end user may be direct, such as labels on the product, or indirect, through various intermediaries (e.g., distributors). The media through which the information is communicated may also be quite varied. Feedback between various components may be involved, such as an employer notifying the manufacturer about a safety problem associated with the use of the product.

Even more complex warning systems could have several receivers, including distributors, employers, and end users. These receivers might differ markedly in several important respects. For example, an employer's industrial toxicologist who may be a receiver in the communication process will probably have a great deal more technical knowledge than a laborer working in the plant who is the end user of the product. This knowledge difference may have implications for the warning system associated with the product. A parallel example, is that given at the outset of the chapter, where there are at least two kinds of users with respect to medications manufactured by a drug company (e.g., a prescribing physician, pharmacists, and a patient who are all targeted receivers of safety information).

Whether the circumstances are simple or complex, the success of a warning communication system depends on accounting for the properties of the various system components. Previous research has examined issues related to the source, the medium, and the message. In this chapter, we focus on the receiver. We review the literature on the most commonly addressed receiver characteristics and present warning-design implications that stem from these characteristics. This chapter is organized into four sections: demographic variables, competence, familiarity, and risk perception. Finally, we offer observations that warning designers should consider with respect to the receiver.

39.2 Demographic Variables

Demographics are statistical characteristics of individuals that can be used for the purpose of grouping. It is easy to collect such data and many warning-related studies have done so in the past. Two common demographic variables are gender and age.

Although gender was the variable of interest in these studies, it remains unclear as to whether gender is truly responsible for the observed results. Specifically, gender may simply act as a proxy or alias for another variable or group of variables (e.g., familiarity). Young et al. (1989) demonstrated that greater hazard ratings were given by females to products that they used infrequently. Other studies have shown that familiarity and product hazard ratings are negatively correlated (Otsubo, 1988; Young, 1996; Wogalter et al., 1987; Young et al., 1990). It may be that females and males would rate product hazards similarly if females only used the products more frequently and/or had greater knowledge about them generally or their hazards specifically. However, other studies suggest that this hypothesis may not be true. For example, Godfrey and Laughery (1984) showed that females underestimated the risks associated with tampon use due, in part, to their familiarity with the product. Karnes and Leonard (1986) examined male and female knowledge of hazards associated with a contraceptive device (an IUD) based on a safety-related pamphlet. Males were included in the subject sample specifically because it was assumed (whether true or not) that they would serve as a low-familiarity control to the females. Females in this study perceived the risks to be significantly higher than did the males.

Conclusions: Gender

These studies suggest that gender effects may or may not be observed in research that does not specifically address gender issues. Evidence tends to suggest that females are more willing to act safely with products (e.g., read or comply with warnings) than are males. However, it is unclear whether this trend would be observed in all situations and with all products. It is also unclear whether gender is the true source of observed differences in product perceptions or whether those differences are related to more basic considerations (e.g., knowledge of the hazards, familiarity, frequency of use, etc.). Further systematic research, which accounts for confounding variables (e.g., familiarity, etc.), is needed before design considerations with regard to warnings can be provided.

Age

When considering age, it is generally believed that (a) older people tend to be more risk averse and (b) younger people (especially younger males) tend to be predisposed to taking greater risks. Smith and Watzke (1990) demonstrated that older people (30 to 59 years, 60 to 75 years, and over 75 years old) more carefully consider the risks and are more cautious than younger adults (under 30 years of age). The authors suggest that cautiousness may be a characteristic of older adults and that this characteristic may start to exhibit itself in the middle years of life (between 30 and 59 years of age). If it is true that people are more or less risk averse depending on their age, then this should manifest itself in safety-related behaviors (e.g., looking for, reading, and complying with warnings). For example, older people (> 25 years old) are more likely to wear seatbelts than younger individuals (< 25 years old) (Leonard et al., 1989). Desaulniers (1991) found that older people, 40 and above, reported being more likely to take precautions in response to warnings.

There are many hypotheses as to why age may influence risk perceptions and/or safety-related behaviors, but the most reasonable ones surmise that younger people do not actually take risks in a formal sense. Specifically, they do not consider an action with a conscious view toward the costs and benefits of acting one way over another (see Lehto, 1991; Wagenaar, 1992). As such, their behavior may appear to be nonrational and more dangerous than the types of judgment-based behavior exhibited by older individuals. While a great deal of evidence for risk-taking in younger people can be found in the literature on traffic accidents (see Edwards and Ellis, 1976; Leonard et al., 1989), there is somewhat less evidence of this phenomenon in day-to-day behaviors. Thus, it is not surprising that the literature is not entirely consistent in demonstrating age effects.

For example, Mazis, Morris, and Gordon (1978) showed that a sample of premenopausal females preferred longer and more detailed information regarding the risks associated with oral contraceptives, but that this trend was more pronounced for younger subjects (e.g., college-age students) than for older subjects. Purswell, Schlegel, and Kejriwal (1986) demonstrated that older people (>30 years old) exhibited

Cognitive Capabilities

Examples of cognitive competence include requisite technical capacity, language, and reading ability.

Technical Capacity

One of the primary issues in warning design with respect to competence concerns the level of technical information to be communicated. Comprehension of such information is generally a function of the receiver's existing technical knowledge of the domain. Here we are referring to conceptual knowledge that includes both factual information and process understanding (the receiver's mental model). Some examples include: (a) medications where knowledge of physiology may be relevant, (b) chemical reactions that require an understanding of what not to mix with what, and (c) mechanical properties where knowledge is needed to understand the hazards of handling certain kinds of equipment. In formulating warnings, it is important to take into account the relevant technical knowledge of the receiver. Further, the problem may be more complicated in the sense that warnings regarding a particular product hazard may be directed to multiple groups (or receivers) differing in knowledge.

The point to be emphasized here is that the level or levels of knowledge and understanding must be considered. Of course, it is also a valid concern that variability in knowledge about facts and processes exists within the target audience for a particular product warning. There may be various approaches to address these concerns. One approach is to construct a single warning system that will be understood at a range that reaches as many people in the target audience as possible. Another approach is to develop a multiple-component warning system where different components are directed at subgroups varying in technical knowledge. The second approach, as shown in the example provided at the beginning of the chapter, is the one selected for presentation of drug-related information by pharmacies. Physicians receive detailed information about prescription drugs and patients receive summaries of that information.

Language

A second cognitive issue with respect to competence is language. The target audience may know a language different from the majority. A warning printed in only one language is much less likely to be accessible to all potential users. Attempts to deal with this problem include the use of pictorial symbols and printing the message in multiple languages. The latter technique is commonly employed in instruction booklets that accompany various electronic products such as watches and calculators. Signs printed in multiple languages must be either increased in size to accommodate the extra material or, if the size is held constant, they must be more cluttered or dense. Neither of these alternatives is desirable. Also, selection of languages to appear on these signs may not be so straightforward. How many languages does one need in order to cover all potential users? The number could be prohibitively high.

Symbols, on the other hand, provide the promise of non-verbal communication — a method of conveying safety-related information regardless of the language spoken in the population. Research has demonstrated that symbols are effective in attracting user attention (Young, 1991; Laughery and Young, 1991; Wogalter et al., 1996; Young and Wogalter, 1990) and in conveying safety information (Collins, 1983; Collins and Lerner, 1982; Laux et al., 1989). However, the promise of completely non-verbal communication has not been and may not be fully realized. Symbols necessarily involve an abstraction of some message. This method of information display is easier for certain safety-related concepts (e.g., slippery floor) than with others (e.g., biohazard, cancer). Designing symbols to convey information that can be interpreted accurately under many different circumstances can be difficult.

Reading Ability

Many warnings require high levels of reading ability on the part of the receiver. The usual recommendation for general target audiences is a reading level near the elementary school range. An exception to this rule is found in Leonard et al. (1989), who found that college students and other highly educated individuals reported being more likely to read complex warnings than simple ones. The complex warnings in this study were used primarily for more hazardous products. Perceived hazardousness is a factor that

showed that females reported being less likely to read warnings for products with which they are familiar (e.g., tampons). Johnson (1992) showed that willingness to look for and read warning information for scaffolds was negatively related to the number of times workers had previously used scaffolding. Morris, Mazis, and Gordon (1977) showed that about 78% of females read a PPI for oral contraceptives the first time they used the drug, but that less than 11% read the insert when it accompanied subsequent prescriptions. However, other research suggests that unwillingness to look for and read warnings is not exclusively related to familiarity. Leonard et al. (1989) demonstrated that willingness to read warnings for a pest-control product was unrelated to familiarity with that product. In addition, Godfrey et al. (1983) demonstrated that familiarity was not related to subjects' reported willingness to look for warning labels on products perceived as hazardous. However, they also reported being more willing to look for warnings on unfamiliar products when the hazard level was perceived as being low. Thus, familiarity may be one factor, along with other perceptions, that influence the extent to which users may seek information.

Behavioral effects of familiarity have also been demonstrated. Goldhaber and deTurck (1988a, b) showed that previous experience with diving into pools was related to lower likelihood of noticing a "No Diving" sign, a higher likelihood of diving into shallow water, and a lower perception of the risks associated with such activities. Otsubo (1988) showed that people with less experience were more likely to read the warnings for two types of saws.

The above review suggests that the more people become familiar with a product, the less likely they will be to engage in safe behaviors (and vice versa). While this relationship may be linear (or at least monotonic), there is some evidence to suggest that the relationship is nonlinear. Bettman and Park (1980) found that subjects with a moderate level of knowledge or experience relied most on external information when making a product-related decision. People with low and high levels of previous knowledge relied to a greater extent on this external information. The authors suggested that users with high levels of experience did not need the information and that users with low levels did not have the capacity to use it properly. Johnson and Russo (1980) demonstrated that both the linear and nonlinear ("inverted-U") functions were observed in different decision-making tasks.

Conclusions: Familiarity

Research generally suggests that lower levels of familiarity are associated with higher levels of perceived hazard and greater reported willingness to act with caution (and vice versa). The most common explanation for this finding is that greater familiarity is associated with greater knowledge of and appreciation for the product's hazards. However, familiarity with a product is not synonymous with knowledge of the hazards associated with it. People may report being familiar with a product and yet have little or no knowledge of its hazards. Familiarity lies along a continuum — people can have indirect, general familiarity with a product or they can have more direct, specific familiarity (i.e., from lower to higher forms of familiarity). Subjects who provide ratings of familiarity in research studies may not make the distinction between the two types. Thus, they might report a high degree of familiarity with a product that they have very little personal knowledge of or experience with (e.g., they may have heard a lot about a product, but have no direct experience with it).

High levels of perceived familiarity may lull people into thinking that they have greater knowledge of and control over product hazards than they actually have and/or that the products are less hazardous. This perception, coupled with the fact that familiarity may reduce information-seeking behaviors on the part of users, can produce a dangerous situation and a special challenge to safety professionals. That challenge is to make warning information salient (i.e., to attract the attention of familiar users) and to make the information seem relevant. A considerable body of research has addressed various forms of salience. However, there is much less research dealing with relevance issues. Ways to make warnings more relevant can include prioritizing warning information based on users' needs and presentation of information to specific users at intermittent schedules.

consequences. Research has demonstrated that the explicitness with which the consequence information is expressed is an important determinant of perceived hazard and of recall of warning information (Laughery and Stanush, 1989; Sherer and Rogers, 1984). As expected, the more explicit the consequence information, the greater the perceived hazard and the more information recalled. This would hold true for the *Fearful* group of subjects. However, different information may be needed for the other groups. For the *Fearless* and *Informed* groups, information about the potential catastrophic nature of the hazard, about the extent to which exposure to the hazard is voluntary, and/or about the degree of personal control over the hazard may be necessary for these subjects to develop a proper appreciation of the risks.

39.6 Conclusions and Recommendations

In this chapter we have focused on characteristics of receivers that are important in the design of warnings. There are several principles or guidelines that appear warranted on the basis of the analyses presented.

Principle #1 — Know thy receiver. This statement may seem trivial and obvious; yet, as noted earlier, warnings are often designed with little or no regard for characteristics of the people to whom they are directed. Examples include warnings that require reading levels greater that the receiver's capability and that contain unfamiliar, technical terminology. Gathering knowledge and data about relevant characteristics of target audiences may require time, effort and money, but without such information, the warning designer and ultimately the receiver will be at a serious disadvantage. Analyzing existing data, such as demographic information, or collecting new data by conducting surveys may be necessary.

Principle #2 — When variability exists in the target audience, design for the low end of that audience. Whether the variability exists in competence, technical knowledge, familiarity, perception of hazardousness, or other receiver characteristics, it is important that warnings not be designed for the average. While it would be desirable to choose a criterion for warning designs that would include up to 99% of the population, there are several instances in which this may not be possible. For example, warning about such hazards as radon gas will necessarily involve information that may not be understood by all people. It is inappropriate to suggest that warning information should not be provided simply because the information may not be understood by 100% of the population. The point is to consider the variability in the target audience and to design the safety information so that it can be used by as many people in the target audience as is practical.

Principle #3 — When the target audience consists of subgroups that differ in relevant characteristics, consider employing a warning system that includes different components designed for the different subgroups. As in the prescription drug example provided at the beginning of the chapter, different types of information and different levels of detail are provided to different groups of receivers. This information is tailored to the needs and capabilities of these receivers.

A corollary to this principle is: do not try to accomplish too much with a single warning. Consider the current OSHA guidelines regarding the variety of subgroups in the target audience for material safety data sheets (MSDSs). These subgroups include toxicologists, safety engineers, managers, physicians, and end users (such as the laborer using the product). It is unlikely that one warning or pamphlet will be sufficient to meet the informational needs and capabilities of all these users. If the warning system does not include communications designed for the capabilities (both the strengths and weaknesses) of each group, it is probably destined to fail.

Principle #4 — Warnings should be tested using samples of potential receivers. Warning design guidelines (e.g., ANSI, 1991; FMC, 1985; Westinghouse Electric Corporation, 1985) can be used to develop candidate warnings for testing, thereby limiting the number of items that need to be tested. However, it is not always possible to use these guidelines to design a perfect warning system. The guidelines presented here can enable one to develop a preliminary warning. Testing of the warning system could assist the designer in refining and developing an effective system by providing information on ways to modify and improve the warnings. These tests might consist of "trying it out" on a target audience sample to assess comprehension and/or behavioral intentions. Our experience indicates that even such *minimal efforts* are seldom part of the warning design process, but would benefit the produced warning had they been taken.

Goldhaber, G.M. and deTurck, M.A. (1988b). Effectiveness of warning signs: Gender and familiarity effects. *Journal of Products Liability,* 11, 271-284.

Green, P. and Pew, R.W. (1978). Evaluating pictographic symbols: An automotive application. *Human Factors,* 20, 103-114.

Johnson, D. (1992). A warning label for scaffold users, in *Proceedings of the Human Factors Society 36th Annual Meeting* (pp. 611-615). Santa Monica, CA: The Human Factors Society.

Johnson, E.J. and Russo, J.E. (1980). Product Familiarity and Learning New Information, in K.E. Monroe (Ed.) *Advances in Consumer Research.*

Karnes, E.W. and Leonard, S.D. (1986). Consumer product warnings: reception and understanding of warning information by final users, in W. Karwowski (Ed.) *Trends in Ergonomics/Human Factors III, Part B: Proceedings of the Annual International Industrial Ergonomics and Safety Conference* (pp. 995-1003).

LaRue, C. and Cohen, H. (1987). Factors influencing consumers' perceptions of warning: an examination of the differences between male and female consumers, in *Proceedings of the Human Factors Society 31st Annual Meeting* (pp. 610-614). Santa Monica, CA: The Human Factors Society.

Laughery, K.R. and Stanush, J.A. (1989). Effects of warning explicitness on product perceptions, in *Proceedings of the Human Factors Society 33rd Annual Meeting* (pp. 431-435). Santa Monica, CA: The Human Factors Society.

Laughery, K.R. and Young, S.L. (1991). An eye scan analysis of accessing product warning information, in *Proceedings of the Human Factors Society 35th Annual Meeting* (pp. 585-589). Santa Monica, CA: The Human Factors Society.

Laux, L.F. and Brelsford, J.W. (1989). Locus of control, risk perception and precautionary behavior, in *Interface 89: The Sixth Symposium on Human Factors and Industrial Design in Consumer Products* (pp. 121-124). Santa Monica, CA: Human Factors Society.

Laux, L.F., Mayer, D.L. and Thompson, D.B. (1989). Usefulness of symbols and pictorials to communicate hazard information, in *Interface 89: The Sixth Symposium on Human Factors and Industrial Design in Consumer Products* (pp. 79-83). Santa Monica, CA: Human Factors Society.

Lehto, M.R. (1991). A proposed conceptual model of human behavior and its implications for design of warnings. *Perceptual and Motor Skills,* 73, 595-611.

Lehto, M.R. and Miller, J.M. (1986). *Warnings, Volume 1.* Ann Arbor, MI: Fuller Technical Publications (p. 18).

Leonard, S.D., Hill, G.W. and Karnes, E.W. (1989). Risk perception and use of warnings, in *Proceedings of the Human Factors Society 33rd Annual Meeting* (pp. 550-554). Santa Monica, CA: The Human Factors Society.

Leonard, S.D., Matthews, D., and Karnes, E.W. (1986). How does the population interpret warning signals? In *Proceedings of the Human Factors Society 30th Annual Meeting* (pp. 116-120). Santa Monica, CA: Human Factors Society.

Leonard, D.C., Ponsi, K.A., Silver, N.C. and Wogalter, M.S. (1989). Pest-control products: Reading warnings and purchasing intentions, in *Proceedings of the Human Factors Society 33rd Annual Meeting* (pp. 436-440). Santa Monica, CA: The Human Factors Society.

Mazis, M., Morris, L.A., and Gordon, E. (1978). Patient attitudes about two forms of printed oral contraceptive information. *Medical Care,* 16, 1045-1054.

McGuire, W.J. (1980). The communication-persuasion model and health-risk labeling. (pp. 99-122), in L.A. Morris, M.B Mazis and I. Barofsky (Eds.) *Product Labeling and Health Risks: Banbury Report 6,* Cold Spring Harbor Laboratory.

Morris, L.A., Mazis, M.B. and Gordon, E. (1977). A survey of the effects of oral contraceptive patient information. *The Journal of the American Medical Association,* 238, 2504-2508.

Otsubo, S.M. (1988). A behavioral study of warning labels for consumer products: Perceived danger and use of pictographs, in *Proceedings of the Human Factors Society 32nd Annual Meeting* (pp. 536-540). Santa Monica, CA: The Human Factors Society.

Purswell, J.L., Schlegel, R.E. and Kejriwal, S.K. (1986). A prediction model for consumer behavior regarding product safety, in *Proceedings of the Human Factors Society 30th Annual Meeting* (pp. 1202-1205). Santa Monica, CA: The Human Factors Society.

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EDITED BY

Waldemar Karwowski
University of Louisville
Louisville, Kentucky

William S. Marras
The Ohio State University
Columbus, Ohio

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