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PURPOSES AND SCOPE OF WARNINGS

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ABSTRACT

This chapter introduces several major warning-related concepts. Topics include the purposes of warnings and their place in the hazard control hierarchy. The who, what, when and where of warnings are described, followed by a discussion of the concepts of hazard control hierarchy and warning systems. A table of generalized design guidelines derived from the warning literature is presented. Lastly, testing using participants from the target population is recommended to verify warning effectiveness.

INTRODUCTION

Over the last 2 to 3 decades, there has been extensive development of regulations, standards, and guidelines on how and when to warn. During the same time period, there has been substantial research activity on the issues of warning effectiveness. This first chapter introduces several major concepts and sets the scene for the rest of this Handbook.

The foremost issue of this introductory chapter concerns the purposes of warnings. This discussion is followed by a description of the who, what, when, and where of warnings. In addition, the central concepts of hazard control hierarchy and warning systems are discussed. As part of these concepts, several related topics are described including "open and obvious," prioritization, indirect communication, and effectiveness testing. A table of generalized warning design guidelines extracted from research is presented. Referrals to other chapters in this volume are provided for further reference.

PURPOSES OF WARNINGS

Warnings are safety communications used to inform people about hazards so that undesirable consequences are avoided or minimized. Warnings may be used to address a variety of risks encountered during product use, when performing tasks, and in the environment. There are many kinds of warnings. They can be in the form of signs, labels, product inserts and manuals, tags, audio and videotapes, face-to-face verbal statements, and so forth. Visual warnings are generally text and graphics. Auditory warnings can be verbal and/or nonverbal. In work environments, communications occurring during training and supervision frequently include warnings in more than one modality and media (see Cohen, Cohen, Mendat, & Wogalter, chap. 9, this volume).

Warnings have four main purposes or functions. First, warnings are a method for communicating important safety information. This purpose is to provide people adequate information about hazards so that they can make informed decisions on how to avoid getting themselves or others hurt. In order to accomplish this function, warnings also need aspects or characteristics to call attention to themselves usually by incorporating salient features into their design. Second, warnings are intended to influence or modify people's behavior in ways that will improve safety. In other words, warnings are used to promote compliance to directives to avoid hazards. The third purpose follows from the second. Ultimately, warnings are intended to reduce or prevent health problems, workplace accidents, personal injury, and property damage. Fourth, warnings can serve as a reminder to persons who may already know information about the hazard. The warning can assist in calling into awareness information about the hazard that might otherwise be dormant in long-term memory.

There are a two additional points regarding the purposes of warnings. Warning adequacy has become a notable issue in product liability and personal injury litigation in the United States and other countries. Summaries of U.S. court rulings (American Law Institute, 1965, 1998) and the doctrine of strict liability indicates that if a product needs a warning for it to

Handbook of Warnings, Edited by Michael S. Wogalter, © 2006, Lawrence Erlbaum Associates (Mahwah, NJ).

be used safely and if that warning is absent or defective, then the product may be deemed defective (see chapters 45, 46, and 47 by Madden, this volume). Allegations of warning inadequacy are frequently made in injury-related litigation matters. The question may also be termed as whether one entity (usually a manufacturer) adequately shifted responsibility for safe use of a product to the injured party or plaintiff (see Laughery & Wogalter, chapter 48, this volume; Paige-Smith, Laughery, Williams, & Kalsher, chapter 50, this volume; Williams, Kalsher, & Laughery, chapter 49, this volume). For this shift of responsibility to take place, the adequacy of the safety communications is usually judged according to criteria associated with the four main purposes of warnings mentioned earlier.

Another point relates specifically to warnings' function as a method of informing people. This issue concerns people's right to know or informed consent. The notion is that, even in situations where warning effectiveness may not be high, people have the right to be informed about safety issues.

HAZARD CONTROL HIERARCHY

In the United States and other parts of the world, manufacturers are held responsible for providing safe products. Warnings may help by fulfilling a part of that safety responsibility. In determining whether warnings are needed, a precursor (and sometimes ongoing) step that should be taken is the use of a hazard analysis. A hazard analysis determines what hazards a product may pose in foreseeable use and foreseeable misuse. As Young, Shaver, Grieser, and Hall (chapter 32, this volume) describe, hazard analysis may take many forms including fault tree analysis, failure modes analysis, critical incident techniques, reviewing existing databases, and feedback from experts. Hazard analyses may be formally or informally conducted. If potential hazards are identified, the next step is to determine how they can be controlled. There are several ways to prevent hazards from harming people and property. Warnings are not the first choice, however. Rather, warnings are one of several potential tools, including basic engineering controls, that could be implemented. Compared to other methods of protecting people and property, warnings tend to be less reliable and effective.

In safety engineering, there is a well-accepted hierarchy of hazard control. The basic hierarchy is an ordered sequence of preferred approaches for dealing with hazards. Figure 1.1 shows a representation of the basic hierarchy. The first in the sequence is to design the hazard out (eliminate or minimize it). Hazard elimination through alternative design is generally the best method. For example, if a hazardous chemical can be replaced with a safer chemical that has similar cost and effectiveness, then such a reformulation would be advisable in terms of hazard control. Likewise, eliminating a sharp edge without affecting the function of a machine would be a preferred method. Unfortunately, it is not always possible to eliminate or design out all of the hazards in every product and all environments. The powered lawnmower is an example of a product where it is probably impossible to eliminate all potential hazards and still have it function.

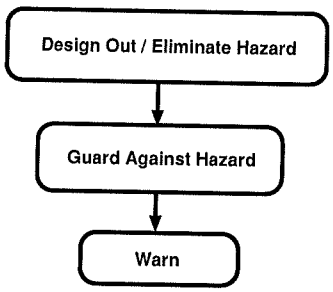

FIGURE 1.1. Hazard control hierarchy.

After trying to eliminate the hazard through design, the next best strategy is to guard against the hazard. The purpose of guarding is to limit contact between people (or property) and the hazard. Guarding can take several forms. Some examples include roadway barricades, a lock on a box enclosing an electrical transformer, and personal protective equipment such as gloves and goggles. These are guards that prevent contact by the presence of a physical barrier. Also procedural guarding can be implemented by designing tasks in such a way to prevent contact with the hazards. One example is the so-called dead-man switch on powered lawnmowers that shuts down the motor when the handle is released. Another example is the physician's prescription necessary to buy certain medications. Like the first strategy of designing out the hazard, guarding is not always feasible to employ.

The third line of defense is to warn. Warnings are the third priority in this sequence because they are not always reliable in preventing contact with hazards. There are several ways that warnings may fail to fulfill the purposes that were outlined earlier. Depending on the circumstances, the person at risk may not see or hear a warning, may not understand it, may not believe it, or may not be motivated to comply with it. Trying to ensure that these mental activities occur successfully can be difficult and challenging. Warnings are seldom foolproof (like hazard elimination and good guarding might be), and this is the reason they are relegated in this scheme as the third best strategy of hazard control. Nevertheless, warnings in the everyday world are being called on to do a lot of work as a method of hazard control. To facilitate the likelihood that warnings will perform their role in promoting safety, they need to be designed well to maximize their effectiveness. Warnings should not be a replacement or substitute for good design or guarding. Warnings better serve as a supplement to good design (Lehto & Salvendy, 1995).

If design, guarding, or warning or a combination of these methods are still not effective in preventing injuries, then there is a fourth level. The last resort is to remove the product or the environment from use. For example, the U.S. Consumer Product Safety Commission (CPSC) has taken this step in banning products when they determine that design, guarding, or warning are not able to prevent serious injuries. One type of product that met this fate was the infant crib pillow. These products were pulled off the market and recalled by manufacturers after

several infants suffocated after being placed on their stomachs on top (or along the side) of these pillows. See Deppa (chapter 41, this volume) on the activities and role of the U.S. CPSC.

WHAT, WHO, WHEN, AND WHERE TO WARN

Assume that a hazard analysis has illuminated that a product, task, or environment has a significant hazard that cannot be either designed out or guarded against. A warning is needed. The issues of what, who, when, and where to warn become important. The topic of how to warn is discussed in a later section concerned with warning systems.

What to Warn

What to warn depends on the particulars of the hazard, the associated product, or environment. Standards, guidelines, and research offer general suggestions on what to warn, but the specifics are likely to differ somewhat from application to application.

Generally the warnings literature suggests that warnings have a signal word panel and a message panel, which might employ text, symbols, or both. A set of basic design guidelines for warnings is provided in Table 1.1 Specifics about these guidelines can be found across numerous chapters in this *Handbook*.

Signal Word Panel. According to most warning standards and guidelines, the uppermost section of a warning is the signal word panel. The signal word panel consists of three parts: (a) signal word (specifically DANGER, WARNING and CAUTION for hazards); (b) color coding (red for DANGER, orange for WARNING, and yellow for CAUTION); (c) an alert symbol (signal icon with an exclamation point inside a triangle). The purpose of the signal word panel is to capture attention and convey a level and probability of injury associated with the hazard (see Peckham, chap. 33; Wogalter & Vigilante, chap. 18; Young, Frantz, Rhoades, & Hall, chap. 34, this volume). Research indicates that although DANGER and the color red connote higher hazard than the two other signal words and colors, they do not interpret a difference between WARNING and CAUTION or orange and yellow (see Hellier & Edworthy, chap. 30, this volume).

Message Panel. The message panel is comprised of three information components: (a) hazard information, (b) instructions, and (c) consequences. This information can be conveyed by language, by symbols, or both.

Hazard information identifies the danger (e.g., high voltage or extremely flammable). Instructions tell what to do or not do to avoid the hazard (e.g., keep out, keep vapors away from all ignition sources). Consequences describe what may happen if the hazard is not avoided (e.g., electrocution or severe burns). Symbols may convey all or parts of these three information components. Symbols can be used as an adjunct or substitute for text if they are adequately comprehensible (see Deppa, chap. 37, this volume).

The use of symbols in warning has both advantages and disadvantages. Potentially, symbols can benefit those who cannot understand the printed text (e.g., low-skilled readers or users of a different language). Symbols can also be used to attract attention to warnings as they are generally more salient than text. However, there are many examples of symbols being used that do not communicate their intended message well. Understandable symbols can be costly to develop, and some concepts may not be amenable to a visual graphic form (Wogalter, Silver, Leonard, & Zaikina, chap. 12, this volume).

Explicit language can enhance warning effectiveness (e.g., Laughery, Vaubel, Young, Brelsford, & Rowe, 1993; Laughery & Paige-Smith, chap. 31, this volume). This can pertain to the description of the hazard, consequences, and instructions. For example, a warning statement telling people exactly what to do or not do is more likely to promote appropriate safety behavior than something more general. However, explicit information tends to be lengthier. Long warnings are not preferred because people may not hold their attention to the warning long enough to encode all of the necessary information (see Wogalter, chap. 5, this volume; Wogalter & Vigilante, chap. 18, this volume). Thus, there is some conflict between the principles of explicitness and brevity, which means that there needs to be a compromise or happy medium between them. Determining the specific wording is addressable by testing, a topic described later in this chapter (see also Laughery & Paige-Smith, chap. 31, this volume).

Sometimes one or more components of a warning can be eliminated because the information can be readily inferred from the other information given in the warning. For example, a sign saying "CAUTION, Slippery Floor" probably does not need the consequence statement "You could fall," because most people recognize this as a potential outcome from the other information given (Wogalter et al., 1987).

Open and Obvious. As previously discussed, all of the separate warning components are not always necessary if the missing information can be readily inferred from the other information given. Similarly, warning labels or signs themselves are not required for every hazard. The concept of *open and obvious* is sometimes used in this context. When a product or environment plainly conveys its hazardous nature by its appearance, then the hazards are considered open and obvious. Everyone except the youngest children knows that scissors can cut and are potentially dangerous. A warning about this hazard is unnecessary. That a person could potentially fall off a cliff in an isolated section of a national park is another example of a hazard that does not require a warning. Everyone knows that uneven terrain occurs in nature and that one needs to watch his or her footing in those contexts. However, footing issues for constructed environments are different. There is an assumption that floors and public walkways are relatively free from trip and fall hazards.

Technology and modern built environments have changed the need for warnings from the preindustrial era when products and environments were almost all open and obvious. Technology has brought numerous hazards that are not plainly apparent. For example, consider the passenger-side air bag embedded

TABLE 1.1. Warning Design Guidance

Aspect	Design Guidelines
Signal Word	• According to ANSI (2002) Z535, signal word panel contains a signal word, color, and alert symbol. • DANGER—Indicates immediately hazardous situation that will result in death or serious injury if not avoided. Use white print on a red background (ANSI Z535.4). • WARNING—Indicates a potentially hazardous situation that may result in death or serious injury if not avoided. Use black print on an orange background (ANSI Z535.4). • CAUTION—Indicates a potentially hazardous situation that may result in minor or moderate injury. Use black print on a yellow background (ANSI Z535.4). • NOTICE—Indicates important nonhazard information. Use white print on a blue background. • Although not in ANSI Z535, the term DEADLY connotes higher levels hazard than DANGER. • On the left side of the panel is the alert symbol (triangle surrounding an exclamation mark). • Signal word is printed in all upper case. • Position panel on upper-most part of the warning.
Message Panel Format	• Orient messages to read from left to right. • Start each statement on its own line. • Consistently position component elements. • Use white space or bullet points to separate statements or sets of statements. • Give priority to the most important warning statements (e.g., position at the top, make larger). • Text should be legible enough to be seen by the intended audience and at expected safe viewing distance. • Text should be high contrast, preferably black print on white or yellow background, or vice versa. • Left-justify text. • Use mixed case lettering. Avoid all caps except for specific word emphasis. • Use san serif fonts (Helvetica, etc.) for signal words and larger text in signs. • Use serif (Times, etc.) fonts for smaller text in labels and accompanying materials. • Use plain, familiar, non-fancy font.
Wording	• Give information about the hazard, instructions on how to avoid hazard, and consequences of failing to comply. • Use short, familiar words. • Use as little text as necessary to clearly convey the message. • Use short statements rather than long complicated ones. • Use explicit—tell exactly what the hazard is, what the consequences are, what to do or not do. • Use concrete rather than abstract wording. • Use active voice rather than passive voice. • Use headline style: Remove unnecessary connector words (e.g., prepositions, articles) in shorter warnings. • Avoid words or statements that might have multiple interpretations. • Avoid abbreviations unless you are sure the target audience knows the meaning. • Use multiple languages when necessary.
Pictorials Symbols	• May be used instead of or as an adjunct to text. • Useful for attracting attention. • May benefit less-skilled readers and readers who do not understand text language. • Some concepts may not be amenable to the production of an understandable symbol. • When used alone, symbols should have at least 85% correct comprehension scores, with no more than 5% critical confusions (opposite or very wrong answers) with a sample of 50 individuals; see ANSI Z535.3. • Minimizing critical confusions is most important criterion. • Symbols not passing a comprehension correct criterion should be accompanied by words. • Development of symbol may require an usability study of multiple design-and-test iterations. • Use bold shapes. Avoid irrelevant graphical details. • Prohibition (circle–slash) symbol should not obscure critical elements of other parts of symbol. • Should be legible under degraded conditions (e.g., distance, small size, abrasion).
Testing	• The criteria in this table are guidelines; some of them conflict (e.g., brevity and explicitness) and some may not be applicable in particular cases. • Hazards, products, and environments differ and so may require unique set of constituents from guidelines. • Usability testing can assist in verifying how well the warning works in applicable situations. • Guidance available for symbol comprehension testing in ANSI Z535.3, but there is no formal standard for testing message panel wording. • Various methods available to test noticeability, legibility, comprehension, attitudes and beliefs, motivation, and compliance. See chapters in this volume including C-HIP model (Wogalter) and usability testing (Wogalter, Conzola, & Vigilante). • User testing can produce input for improvements. • Iterative design and test until a satisfactory warning is produced.
Other	• Position warning where and when needed. • Locate so it will be seen or heard with adequate time to avoid hazard.

inside the dashboards of many vehicles. According to the U.S. National Highway Traffic and Safety Administration (see Foley, chap. 43, this volume), air bags have saved many adult passengers. However, the initial technology installed in many vehicles possessed a substantial hazard to small children and smaller adults positioned in front of them in minor crashes in which they deployed. Without information, a layperson would not be aware of the hazard. Consider, as another example, common household cleaners. Without some form of labeling on the products' containers, purchasers and users would not know what the dangers are. The hazards of these and many other kinds of technology are not open and obvious. Safety information needs to be provided.

Prioritization. When multiple hazards are present, the situation is more complex. Prioritization concerns the ordering of hazards when multiple hazards exist. It often relates to which hazards to emphasize or deemphasize. Decisions regarding prioritization may consist of what to include or delete, how to sequence items, or how much relative emphasis to give to each hazard. According to Vigilante and Wogalter (1997a, 1997b), higher priority should be given to hazards that are (a) more severe, (b) more likely to occur, (c) not known by the target audience, and (d) of higher importance. Another consideration is practicality, which depends on the particular circumstances such as limited space on a label or limited time if presented in a commercial.

The manner in which one carries out the prioritization can vary. As a general rule, important lesser known hazards leading to more severe consequences and/or those more likely to occur should have higher priority than less severe or less likely hazards (Wogalter, Conzola, & Vigilante, chap. 38, this volume). Higher priority warnings should go on the product label. If it is not practical to place all of the warnings on the label, then the lower priority ones might go on other warning system components, such as package inserts or manuals. Higher priority warnings should, in general, be listed first and made more conspicuous (e.g., larger, with color highlighting).

Who to Warn

Generally, who should be warned includes everyone who may be exposed to the hazard (i.e., at risk) and everyone who may be able to do something about it. Warnings may be intended for the general public, such as those associated with consumer appliances. Or they may be directed to a very specific audience. For example, warnings about teratologic substances that cause birth defects might be directed primarily to women of child-bearing age (see Goldsworthy & Kaplan, chap. 59, this volume). Warnings are usually directed at end-users, but they may also be directed at intermediaries such as job supervisors who make decisions about workplace safety, physicians who prescribe medications, and caretakers of children.

Warning design should take into account the lowest ability levels of the target population. Sometimes these abilities relate to sensory-perceptual difficulties, such as reduced visual acuity in older adults (see Mayhorn & Podany, chap. 26, this volume). Thus, larger text is needed than what would be adequate for younger adults (Wogalter & Vigilante, 2003). Sometimes the difficulties are cognitive, such as limitations on comprehension of technical information. Some portions of the population are not literate in any language, or in the particular language that the warning text may be written. Several chapters in this Handbook consider the relationships between target audiences and warning variables. See, for example, Smith-Jackson's chapters in this volume on culture and receiver characteristics (chap. 24 and chap. 27).

When and Where to Warn

Warnings should be available when and where they are needed. The preferred location for a product warning is usually on the product. However, space constraints or the nature of the product (e.g., a small clamp) may impose such limits. Determination of potential locations for the warning may require a task analysis (Frantz, Rhoades, & Lehto, 1999). A chapter by Young, Frantz, Rhoades, and Wisniewski (chap. 58, this volume) describes a case study about personal watercraft involving task analyses. See also the chapter by Wogalter, Conzola, and Vigilante (chap. 38, this volume) for more information about warning text development.

WARNING SYSTEMS

This section might be rightly called how to warn. As described in the following, the idea that a warning is only a sign or a portion of a label is too narrow a view of how safety information gets transmitted.

Multiple Modalities and Media

Most warnings are communicated visually by printed text and symbols and auditorily through sounds and verbal messages. Besides these two modalities, the other senses have been used to warn of hazardous conditions, for example, adding an odor to natural gas to aid in detection and tactual feedback to automobile drivers through rumble strips. In addition, more than one modality may be used to convey a warning. Commonly a warning is more than a label. Many media can be involved including brochures, posters, face-to-face communication, televison advertisements, and so on. Multiple printed messages in different formats and containing different information may be used. Moreover, the receiver or target audience may include different subgroups with varying characteristics and circumstances. Such warning situations frequently occur.

An example involving multiple entities and distribution of warnings may be useful. Suppose the product being used in a factory is acetone. Acetone is a solvent with a very low flashpoint and is labeled as Extremely Flammable. Sparks coming from ignition sources including pilot lights, motors, and electric devices could ignite a fire that quickly spreads. Another important characteristic of acetone is that the vapors are heavier

than air and can travel along the ground to some distance away (and are thereby capable of reaching relatively distant ignition sources).

Several entities may be involved in the acetone distribution and the distribution of associated safety information. The manufacturer of the acetone would likely put out warnings intended for the end-user and other entities that may be involved such as distributors and employers. The distributor may pass on warnings to employers that it received from the manufacturer and then employers may pass on the information to their employees. Each of the downstream receivers may add some of their own warnings to the mix. Of course, for everyone to appropriately pass on warnings in this manner is a best case scenario. The reliability is not perfect. Some warnings may not be delivered dowstream as intended. Well-designed product labels attached to the acetone containers are more likely to make it to end-users in comparison to other kinds of information delivery methods, such as material safety data sheets (MSDS) and brochures that are separate from the product.

As the acetone example suggests, the warnings received by an employee could take different forms. The situation is somewhat different in nonemployment settings, namely, with consumers and consumer products and public environments. Training is an option that is usually less often available or is less extensive for consumer products compared to the employer-to-employee situation. Moreover, the target audience is often quite varied with respect to sensory capabilities and cognitive skills and abilities. Furthermore, hazardous situations may occur in a wide assortment of conditions and tasks. Clearly, a single kind of warning disseminated by a manufacturer will be unable to directly reach everyone who may be at risk. Thus, when the target audience varies, a warning system that includes a multimethod approach is needed involving different forms of components (Laughery & Wogalter, 1997).

Thus, in the context of the acetone example, the components of its warning system could include a variety of media and messages (such as the label, MSDS, brochure). Similarly, a warning system for an over-the-counter (OTC) multisymptom cold medication may consist of several components: a printed statement on the box, a printed statement on the bottle, and a printed package insert. In addition, there may be text and/or speech warnings in television advertisements about the product. Organizations including government agencies and consumer and trade groups might also disseminate additional materials. Also, information is increasingly being made available on manufacturers' and others' Web sites.

The components of a warning system are not necessarily identical in terms of content or purpose. For example, some components may be intended to capture attention and direct the person to another component where more information is presented. In the acetone example, the label on the product container may be intended for end-users and everyone associated with its use and storage, whereas the information in the MSDS may be more oriented to professionals such as fire personnel, industrial toxicologists, or safety engineers working for the employer (Smith-Jackson & Wogalter, in press).

Direct and Indirect Communications. The distinction between the direct and indirect effects of warnings involves the paths by which the information gets to the target person. A direct effect occurs as a result of the person being directly exposed to the warning. That is, he or she directly reads or hears the warning. Warnings can also accomplish their purposes when delivered indirectly. A woman may not read the warnings about toxic shock syndrome (TSS) on a tampon box because she has used tampons for many years without a problem, but she learns about the TSS hazard in a conversation with her neighbor. Work supervisors and physicians may verbally communicate warning information that they read to their employees or patients. Moreover, the print and broadcast news media may present information that is also provided in warning labels. The point is that a warning disseminated by a manufacturer may still have utility even if the consumer or user is not directly exposed to the warning, as the warning may be received by others who communicate the information to the end-user.

There are situations where there is reliance on indirect communications to transmit warning information. Employers, physicians, and caretakers of children have that responsibility. As part of the systems approach, empowering indirect warnings could benefit the spread of information about hazards.

SUMMARY AND CONCLUSIONS

Warnings should not be expected to perform the task of remedying bad design. As a strategy of hazard control, warnings should be considered a last resort after design and guarding have been considered and implemented where possible. As a means to protect people and property, warnings should be designed so that they have a good chance of doing that job.

There are several general rules to maximize warning effectiveness. As a rule, warnings should be brief. Longer warnings or those with nonessential information are less likely to be read. At the same time, important information should not be omitted. Thus, the brevity criterion conflicts to some extent with the explicitness criterion. Being explicit about every hazard could result in very long warnings. Finding a happy medium between brevity and explicitness and other compromises among the design guidelines given in Table 1.1 may be challenging. Some of that decision making could come from testing (see Wogalter, Conzola, & Vigilante, chap. 38, this volume).

Prioritization concerns what hazards to warn about and to emphasize when more than one hazard exists. Decisions about priority include what to include or delete, how to sequence items, and how much relative weight to give them. As a general rule, lesser known, more severe, and more likely hazards should have precedence over well-known, less severe, and less likely hazards. If limited from putting all of the important warnings on the product or container, then the choice is to put higher priority warnings there, and less important (lower priority) information can be placed in other warning system components, such as package inserts or product manuals.

There is usually variability in target populations in terms of sensory capabiliy, competence, experience, knowledge, and beliefs. In such cases, design should not be aimed simply toward the average person. Rather, warnings should be designed considering persons at the lower end of sensory capability, competence, experience, and knowledge as much as possible. When

the target audience consists of subgroups who may be involved with the product or environment under different conditions, the warning system ought to incorporate different and redundant components. A single kind of warning may not reach everyone in the target audience. A systems approach to safety communications is needed to reach different target users.

Although there is a growing body of research and design guidelines, it is frequently necessary to carry out some sort of testing to evaluate the adequacy of the warning. Although one may have followed many of the guidelines in Table 1.1, the warning may not be adequate because of the unique characteristics of products, environments, and people. Getting feedback from domain experts and users will assist in producing warning systems that inform, promote safety behavior, reduce injury, and remind users at the appropriate time.

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