10 Warning Labels, Instructions, and Product Liability

10.1 LEARNING GOALS

10.2 KEY TOPICS

- Types of product liability
- Hazard classification
- Principles of warning label design

10.3 INTRODUCTION AND BACKGROUND

In addition to promoting safety and healthy work practices in the occupational environment, the field of ergonomics is equally concerned with promoting consumer product safety through safe product design and use (Wilson and Kirk, 1980). During the past several decades, there has been an increasing concern for public safety in the United States in terms of consumer products. The Consumer Product Safety Commission (CPSC), an independent federal regulatory agency, established by the Act of October 27, 1972 (86 Stat. 1207), has the mission to ensure the safety of consumer products manufactured, distributed, and marketed in the American industry. The commission has primary responsibility for establishing mandatory product-safety standards in order to reduce unreasonable risk of injury to consumers from consumer products. It also has the authority to ban hazardous consumer products. The responsibilities are defined as follows:

> The primary responsibility of the CPSC is to protect the public from unreasonable risks of injury that could occur during the use of consumer products. The CPSC also promotes the evaluation of consumer products for potential hazards, establishes uniform safety standards for consumer products, eases conflicting state and local regulations concerned with consumer safety, works to recall hazardous products from the marketplace, and selectively conducts research on potentially hazardous products. (CPSC, 2011)

Additionally, the Consumer Product Safety Act (15 U.S.C. 2051 et seq. [1972]) authorizes the commission to conduct extensive research on consumer product standards, to engage in broad consumer, industry information, and education programs, and to establish a comprehensive injury-information clearinghouse (CPSC website,

2011). This responsibility is increasingly more challenging with the globalization of product development and manufacturing.

Manufacturers, service industries, and recreational environments are continually implementing strategies that promote safer products, environments, and processes to reduce the likelihood for injury to employees, and organizational liability. Ensuring safety in design and redesign is accomplished through

- Engineering design
- Administrative controls
- *Hazard communication through warning labels*

The distinction between warnings and instructions is offered by Laughery and Wogalter (1997) stating that warnings are communication about safety while instructions may or may not contain information regarding safety.

The least desirable among these three approaches to risk reduction is warning as this approach is completely dependent upon the response of the consumer to be effective. This approach should be used in conjunction with design and administrative controls.

As technology increases, product liability should decrease; however, this has not always been the case in all industries. The improvement in product design and manufacture leads to better products but it also introduces new hazards (i.e., risk of damage to the ears with enhanced quality earphones). Technologies such as computers allow for better design, not only in the product, but also in the workspaces using resources such as simulation to anticipate and model potential hazards to employees and consumers (Ettlie, 1998).

10.3.1 Impact of Product Liability on Ergonomics and Human Factors in Product Design

With the threat of product liability looming over manufacturers, ergonomist often work closely with safety engineers in product design to ensure a well-designed product. U.S. Ergonomics, Inc. (2010), a multidisciplinary team of Certified Professional Ergonomists, "specializes in the application of measurement-based technologies to assess the human response to product and/or workplace design. The results of these analyses are used to improve comfort and efficiency while reducing fatigue potential, injury risk and liabilities". This ensures that the product designed meets the requirements as well as decreases potential liability. This testing is important, because oftentimes manufacturers will protect themselves by deciding not to pursue a product after testing, in order to avoid product liability. This may lead to "discontinued product research, cut backs on introducing new product lines with known risks, and increase product cost in order to design to mitigate risks. Ultimately, the abuse of product liability laws offers consumers fewer domestic products at higher prices and compromises the competitiveness of U.S. firms in foreign and domestic markets" (American Tort Reform Association, 2007). However, the benefits of product liability are many including safe and healthy consumer products as well as responsible manufactures.

10.4 DEFINITIONS

In this section, several terms are defi
and risk perception. These terms
meanings. Therefore, it is importa

Hazard is a term that is used to
injury, illness, or property damage
of the environment, of equipment,
tant to take into consideration that
the people involved, for example,
can be defined in several ways. In
ard and likelihood. Risk perceptio
regarding the hazards, likelihoods,
circumstances.

10.5 PRODUCT LIABILITY

According to the Cornell Univers
uct liability is defined as follows (C

> Products liability refers to the liabil
> facture of any product for damage
> facturer of component parts (at the
> wholesaler, and the retail store
> inherent defects that cause harm to
> the product was loaned, given, etc.
> products are generally thought of
> stretched that definition to include
> and writings (navigational charts,

The theories of product liability
and have been written about
2001). These theories are

1. Negligence
2. Strict liability
3. Breach of warranty

Sometimes all three theories are
breach of warranty may include
legal dictionary (http://legal-dictio
"Misrepresentation refers to a
a product gives consumers false
done by drawing attention away
tional concealment of potential
Discussions of each of these theories
Law Dictionary, 2011).

10.4 DEFINITIONS

In this section, several terms are defined, particularly the concepts of hazard, danger, and risk perception. These terms are sometimes used in different ways with different meanings. Therefore, it is important to be clear as to their meaning in this context.

Hazard is a term that is used to describe a set of circumstances that can result in injury, illness, or property damage. Such circumstances may include characteristics of the environment, of equipment, and of a task someone is performing. It is important to take into consideration that circumstances can also include characteristics of the people involved, for example, their abilities, limitations, and knowledge. Danger can be defined in several ways. In this chapter, it is defined as the product of hazard and likelihood. Risk perception involves the overall awareness and knowledge regarding the hazards, likelihoods, and potential outcomes of a situation or set of circumstances.

10.5 PRODUCT LIABILITY

According to the Cornell University Law School's Legal Information Institute, product liability is defined as follows (Cornell, 2009):

> Products liability refers to the liability of any or all parties along the chain of manufacture of any product for damage caused by that product. This includes the manufacturer of component parts (at the top of the chain), an assembling manufacturer, the wholesaler, and the retail store owner (at the bottom of the chain). Products containing inherent defects that cause harm to a consumer of the product, or someone to whom the product was loaned, given, etc., are the subjects of products liability suits. While products are generally thought of as tangible personal property, products liability has stretched that definition to include intangibles (gas), naturals (pets), real estate (house), and writings (navigational charts). (Legal Information Institute, 2010)

The theories of product liability are generally classified in one of three categories and have been written about extensively (Gasaway, 2002; Kinzie, 2002; Moore, 2001). These theories are

1. Negligence
2. Strict liability
3. Breach of warranty

Sometimes all three theories are pursued in one case. Also, strict liability and breach of warranty may include cases of misrepresentation. According to the legal dictionary (http://legal-dictionary.thefreedictionary.com/Product+Liability), "Misrepresentation refers to a situation when a manufacturer, distributor or seller of a product gives consumers false security about the safety of the product; this is often done by drawing attention away from the hazards of its use. Fault lies in the intentional concealment of potential hazards or in negligent misrepresentation."
Discussions of each of these theories are provided in the following sections (Black's Law Dictionary, 2011).

10.5.1 Negligence

A negligence theory requires the plaintiff to prove four elements:

- First, it must be shown that the defendant owed a duty to the consumer.
- Second, that the manufacturer did not guard against injuries likely to result from a reasonably foreseeable misuse of the product.
- Third, that the manufacturer breached its duty (by applying the aforementioned design defect, manufacturing defect, or failure to warn theories).
- Fourth, plaintiff need also prove he or she was injured and that the manufacturers' breach caused the injury.

Failure to warn may be the case if, a manufacturer who sells a painkiller without warning that use of the drug with alcohol could impair the user's ability to operate machinery. In this case, the manufacturer may be liable if the consumer is injured in this fashion.

Defective design claims that a product is, at the time it is sold, in a defective condition and is unreasonably dangerous to the ordinary consumer. For example, a seller who designs a circular power saw that does not include a blade guard may be liable if the user suffers an injury from the unguarded blade.

10.5.2 Strict Liability

Strict liability is essentially identical to negligence theory except the plaintiff need not show knowledge or fault on the manufacturer's part. In other words, the plaintiff still must show the four elements of negligence but the knowledge of the product's unreasonable danger (if the product is proven unreasonably dangerous) is attributed to the manufacturer. The following question then arises: "would the reasonable manufacturer, with such knowledge of the product's risk, have produced the product?"

Usually, the defendant (manufacturer) has knowledge or should have had knowledge and the attribution of knowledge is irrelevant. In cases where it cannot fairly be said that the manufacturer had knowledge or should have had knowledge of a product's risk (such as, possibly, asbestos manufacturers many decades ago), if strict liability is properly applied knowledge will be attributed. Strict liability concerns only the condition of the product while negligence is concerned not only with the product but also the manufacturer's conduct. Causation and damages are the same as they are for negligence but the primary difference in strict liability lies with defect. Seven factors must be analyzed to verify a defect (Black's Law Dictionary, 2011):

- The product's usefulness
- The availability of safer products to meet the same need
- The likelihood and probable seriousness of injury
- The obviousness of the danger
- The public expectation of the danger
- The avoidability of injury by care in the use of the product, including the effect of instructions and warnings
- The manufacturer's or seller's ability to eliminate the danger of the product without making it useless or unduly expensive

However, it is important to point out
liability." Thus, just because a person
ity and automatically recover but rath
liability still must prove his or her rig

Strict liability does not take into
focuses on the quality of the product th
to prove that the product is defective
sumer needs to prove three main elem

10.5.3 Breach of Warranty

The final product liability theory is th
on the premise that "every product
its intended use. A defective product
use and thus may constitute a breach
claim such a warranty but will be held

The performance and reliability
the product design and guidance pro
and software performance characteris
performance, are more reliable and
According or Priest and Sanchez, the
are as follows (Priest and Sanchez,

- Simple and effective human inte
formance, reduce human error
also increases the number of pro
metrics, ergonomics, repairabilit
- Functional task allocation anal
effectively dividing performan
the machine, assistive devices,
- Task analysis, failure modes,
product liability analysis are use
and correct potential problems
- Design guidelines and analysis
standardized/common tasks and
sonal performance.
- Prototype testing of task perform
used to identify design improve
- Effective design documentation
repair instructions.
- Safety hazard and product liabil
hazards including all foreseeable

Safety and product liability analyses
performed in appropriate and inappro
omist must consider foreseeable

However, it is important to point out that "strict liability" does not mean "absolute liability." Thus, just because a person is injured, he or she cannot assert strict liability and automatically recover but rather the injured consumer who is asserting strict liability still must prove his or her right to compensation.

Strict liability does not take into account the conduct of the parties but instead focuses on the quality of the product that caused the injury. The consumer only needs to prove that the product is defective. In order to establish strict liability, the consumer needs to prove three main elements: causation, damages, and defect.

10.5.3 Breach of Warranty

The final product liability theory is that of breach of warranty. This theory is based on the premise that "every product comes with an implied warranty that it is safe for its intended use. A defective product that causes injury was not safe for its intended use and thus may constitute a breach of warranty. A manufacturer cannot simply disclaim such a warranty but will be held responsible if its product is deemed defective.

The performance and reliability of any product depends on the effectiveness of the product design and guidance provided to the user. Regardless of the hardware and software performance characteristics of a design, some designs result in better performance, are more reliable and safer than others (Priest and Sanchez, 1988). According or Priest and Sanchez, the best practices to successfully design for people are as follows (Priest and Sanchez, 1988):

- Simple and effective human interface: this is necessary to promote good performance, reduce human errors and system-induced errors. A simple design also increases the number of potential users when the principles of anthropometrics, ergonomics, repairability, safety, and product liability are considered.
- Functional task allocation analysis: this maximizes system performance by effectively dividing performance, control, and maintenance task between the machine, assistive devices, and the operator.
- Task analysis, failure modes, maintenance analysis, safety analysis, and product liability analysis are used to analyze human requirements, identify and correct potential problems, and predict operator performance.
- Design guidelines and analysis promote mistake proofing with simplified, standardized/common tasks and human interface designs to improve personal performance.
- Prototype testing of task performance including repair and manufacturing is used to identify design improvements, potential human errors, and hazards.
- Effective design documentation is critical for user, manufacturing, and repair instructions.
- Safety hazard and product liability analyses identify and correct all potential hazards including all foreseeable uses, foreseeable misuses, and modifications.

Safety and product liability analyses require that a critical review of a product be performed in appropriate and inappropriate product use. Safety engineers and ergonomist must consider foreseeable misuse of the product. This should result in the

evaluation or consideration of all possible hazards. The implementation of hazard, ergonomic, and safety analysis in the design stage are very valuable in the design phase; however, the greatest dividends of these actions are in the reduction in product-related accidents, product misuses, recalls, and liability costs.

10.5.3.1 What Is a Hazard?

A hazard is any condition or situation (existing or potential) that is capable of injuring people or damaging the product, adjacent property, or the environment (Priest and Sanchez, 1988). The steps in an effective hazard analysis are as follows (adapted from Priest and Sanchez, 1988):

- Identify hazards by level.
- Identify the reasons and factors that can produce the hazard.
- Evaluate and identify all potential effects of the hazard.
- Categorize the identified hazards as catastrophic, critical, marginal, or negligible.
- Implement design changes that minimize the number and level of hazards.
- Determine if administrative controls (i.e., training, personal protective equipment) should be used.
- Develop a plan to provide warnings and instructions to end users to inform of minimal hazards (or any other hazards) that are not removed from the design.

DoD MIL STD 882, System Safety Program Requirements, classifies hazard severity as follows:

It is very important for manufacturers to evaluate the hazardous characteristics of their products during the product development process. This assessment can be part of a preliminary hazard analysis, a failure mode and effects analysis, or some other test of a product before its final design is approved and further actions to eliminate or control any hazards take place (shown in Table 10.1).

10.5.4 Warnings

Warnings inform people of hazards and provide instructions as to how to deal with them in order to avoid or diminish undesirable consequences. Warnings are used to address environmental hazards as well as hazards associated with the use of products. The increased use of warning signs has been accompanied by regulations,

TABLE 10.1
DoD Hazard Classification

Severity	Category	Accident Definition
Catastrophic	I	Death or total system loss
Critical	II	Severe injury, severe occupational illness, or major system damage
Marginal	III	Minor injury, minor occupational illness, or minor system damage
Negligible	IV	Less than minor injury, occupational illness, or system damage

standards, and guidelines
or ergonomists, have played
technical literature that has

Warnings are intended
result in injury, illness, or
to influence or modify people's
level, warnings are meant
hazards, consequences,
make informed decisions.
context, it is important to
because it can have implications
typical and basic model
which a message is transmitted
product, the worker, or any
transmitted. The medium
is transmitted. Additional
design of the message,
are shown in Table 10.2

The sender of a message
sible, legible, and readable

TABLE 10.2
Factors Affecting

Design of Message — by Sender

Comprehensibility
- Purpose
- User knowledge
- Brevity
- Accuracy
- Clarity

Legibility
- Font style
- Font size
- Colors

Readability
- Borders
- Layout
- Abbreviations
- Spacing
- Case

Source: Adapted from

standards, and guidelines as to when and how to warn. Human factors specialists, or ergonomists, have played a significant role in the research of warnings and the technical literature that has resulted.

Warnings are intended to improve safety by decreasing accidents or incidents that result in injury, illness, or property damage. At another level, warnings are intended to influence or modify people's behavior in ways that improve safety. At still another level, warnings are meant to provide information that enables people to understand hazards, consequences, and appropriate behaviors, which in turn allows them to make informed decisions. Also, warnings can be viewed as communications. In this context, it is important to describe the typical communications model or theory, because it can have implications in the design and implementation of warnings. A typical and basic model includes a sender, a receiver, a channel or medium through which a message is transmitted, and the message. The receiver can be the user of the product, the worker, or any other person to whom the safety information must be transmitted. The medium refers to the channels or routes through which information is transmitted. Additional factors impacting the quality of communication are the design of the message, environment, and external influences. Some of these factors are shown in Table 10.2 (Eastman Kodak Company, 1986).

The sender of a message must design written material so that it is comprehensible, legible, and readable (column 1). Factors that influence each of these design

TABLE 10.2
Factors Affecting the Written Communication

Design of Message → by Sender	Factors Affecting → Message Transmission	Elements Influencing Receipt of the Message
Comprehensibility	*Environment*	*Discrimination*
• Purpose	• Viewing distance	• Visual abilities
• User knowledge	• Viewing angle	
• Brevity	• Illumination	*Interpretation*
• Accuracy	• Deterioration	• Language skills
• Clarity	• Competing displays	• Situation knowledge
	• Timing pressure	
Legibility		*Recall*
• Font style		• Time delay
• Font size		• Interference
• Colors		
Readability		
• Borders		
• Layout		
• Abbreviations		
• Spacing		
• Case		

Source: Adapted from Caplan, S.H., 1975; Eastman Kodak Company, 1986.

objectives are listed. As the message is transmitted through the environment (column 2), other factors may affect how well it can be picked up by the receiver. The receiver's characteristics (column 3) also influence the accuracy with which information is communicated. Attention to the factors listed in each part of the process should reduce the potential for errors in written communication.

Ideally, all products should be designed with safety as a priority. However, some products have inherent risks and safety is not always achieved through design alone. Three approaches when making a product safe for consumer use are as follows:

- Firstly, the dangerous features out of the product should be designed. If that is not possible, the second approach is to mitigate or protect from the hazard or engineered out of the design (i.e., guarding or shielding).
- Secondly, administrative controls or personal protective equipment can be used to mitigate risk in some cases. This includes requirements for training, certification on product use, and provision of protective items such as work goggles.
- Finally, if a hazard is still evident, adequate warnings and instructions must be provided for proper use and reasonable foreseeable misuse. Warning signs or labels are used to warn users of the dangers that come with the use of the product. Although, instructions for products often contain warnings, warnings are not instructions. Instructions are provided for the product's safe use and to prevent any injuries or damages.

The objective of a warning sign is to alter behavior. The warning must be sensed audibly, visually, or through olfactory (i.e., smell of natural gas), received through reading or listening, and understood, which should ultimately lead to adherence. Warning design can be a very complex task and where the risks of serious injury or death are involved, warnings should be tested for effectiveness with potential users. Several principles or rules are used to guide when a warning should be used. The following list can be used to determine whether a warning is necessary (Laughery and Wogalter, 1997):

1. A significant hazard exists.
2. The hazard, consequences, and appropriate safe modes of behavior are not known by the people exposed to the hazard.
3. The hazards are not open and obvious; that is, the appearance and function of the environment or product do not communicate them.
4. A reminder is needed to assure awareness of the hazard at the proper time. This concern is especially important in situations of high task loading or potential distractions.

If a warning label is needed, it is important to design and place it such that it will be perceived, sensed and received. In order to determine if a warning will be easily sensed, the following factors need to be considered:

- Orientation
- Location

- Size, including
- Shape
- Color
- Graphical design
- Contrast
- Attention getting

All warning signs or
American National Stand
1991), which requires
(Figure 10.1):

1. The signal word is
   a. Danger
   b. Warning
   c. Caution
2. The statement
3. The probable
4. Instructions on how
5. The label has the
   a. Danger
      i. White letters,
   b. Warning
      i. Black letters,
   c. Caution
      i. Black letters,

FIGURE 10.1 Example of

- Size, including font size
- Shape
- Color
- Graphical design
- Contrast
- Attention getting aspects, for example, a flashing light

All warning signs or labels should follow the guidelines as outlined by the American National Standard for Product Safety: Signs and Labels (ANSI Z535.4-1991), which requires all warnings to comply with the following five criteria (Figure 10.1):

1. The signal word is appropriate to the level of hazard.
   a. Danger
   b. Warning
   c. Caution
2. The statement describes the hazard.
3. The probable consequences of involvement with the hazard are described.
4. Instructions on how to avoid the hazard are included.
5. The label has the appropriate colors, graphics, and pictorials.
   a. Danger
      i. White letters, red background
   b. Warning
      i. Black letters, orange background
   c. Caution
      i. Black letters, yellow background

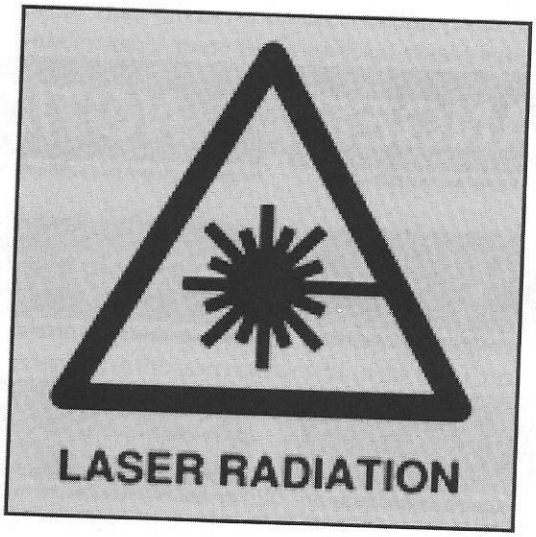


FIGURE 10.1 Example of Warning label.

The levels of signal words are as follows (Figure 10.2):

- Danger
  - Used when there is an immediate hazard and if encountered it can result in severe injury or death
- Warning
  - Used for hazards or unsafe products
- Caution
  - For hazards or unsafe practices that could usually result in minor personal injury, product damage, or property damage

Sensing a warning does not necessarily mean that it will be received. Several factors can influence receipt or reading of warnings, such as familiarity with the product, complexity of warning, length of warning, and numerous others. It is important that the words and graphics of a warning are understood by the user population. The minimum information necessary in a warning includes the following:

- Signal word
  - To convey the gravity or severity of the risk
- Hazard
  - Description of the nature of the hazard
- Consequences
  - Describes what will happen in case the warning is not heeded
- Instructions
  - Provides the appropriate behavior needed to reduce or eliminate the hazard

Sensing, receiving, and understanding a warning does not necessarily mean that it will also be heeded. Cost of compliance is one of the factors that can impact a

FIGURE 10.2 Samples of signal word usage.

person's likelihood to heed a wa
energy, time, resources, or devia
the warning requires. The high
compliance. Other factors affect
the risk acceptance level of the i

10.5.5 Prioritizing Warnin

An important concern with haza
about when multiple hazards exi
include or omit, how to sequence
a hazard is already known and
however, depending on the use
provide a warning. Other factor
Wogalter, 1997):

- Likelihood
  - The more likely an un
    that it should be warne
- Severity
  - The more severe the
    priority that it should
    contact hazard, a high
    burn consequence than
- Practicality
  - There are occasions wh
    time, for example, a tas
    to be addressed in a sit
  - As a general rule, un
    quences and/or those
    primary warning com
    those hazards with low
    components, such as pa

10.5.6 Active versus Passive

Active warnings usually have sen
to an imminent danger. Although
passive warnings are used more
label of a product as well as in the

10.5.7 Design of Warnings

There are several principles th
characteristics into account
Laughery, 2006):

person's likelihood to heed a warning. Cost of compliance refers to the degree of energy, time, resources, or deviation from the activity at hand that complying with the warning requires. The high cost of compliance results in a low probability of compliance. Other factors affecting a person's decision to follow a warning include the risk acceptance level of the individual and the ability to remember the warning.

10.5.5 Prioritizing Warnings

An important concern with hazards deals with the question of what hazards to warn about when multiple hazards exist. How are priorities defined when deciding what to include or omit, how to sequence them, or how much emphasis to give them? When a hazard is already known and understood, obvious warnings may not be needed however, depending on the user and environment, the designer may still want to provide a warning. Other factors that should be considered include (Laughery and Wogalter, 1997):

- Likelihood
  - The more likely an undesirable event is to occur, the greater the priority that it should be warned.
- Severity
  - The more severe the potential consequences of a hazard, the greater priority that it should be warned. If a chemical product poses a skin contact hazard, a higher priority would be given to a severe chemical burn consequence than if it were a minor rash.
- Practicality
  - There are occasions when limited space, such as a small label or limited time, for example, a television commercial, does not permit all hazards to be addressed in a single component of the warning system.
  - As a general rule, unknown hazards leading to more severe consequences and/or those more likely to occur would have priority for the primary warning component, such as on the product label, whereas those hazards with lower priority would be addressed in other warning components, such as package inserts or manuals.

10.5.6 Active versus Passive Warnings

Active warnings usually have sensors that detect inappropriate use or alert the user to an imminent danger. Although active warnings are preferred to passive warnings, passive warnings are used more commonly. Passive warnings can be found on the label of a product as well as in the instructions within the users' manual of the product.

10.5.7 Design of Warnings

There are several principles that should be considered when taking receiver characteristics into account during the design of warnings (Woolgather and Laughery, 2006):

- Principle 1
  - Know the receiver. Gathering information and data about relevant receiver characteristics may require time, effort, and money, but without it the warning designer and ultimately the receiver will be at a serious disadvantage.
- Principle 2
  - When variability exists in the target audience, design warnings for the low-end extreme.
  - Do not design for the average.
- Principle 3
  - When the target audience consists of subgroups that differ in relevant characteristics and efforts to apply that knowledge, warnings generally should be market tested.
  - Such tests may consist of trying it out on a target audience sample to assess comprehension and behavioral intentions.

Labels and signs for warnings must be carefully designed by adhering to the most recent government laws and regulations, recognized national and international standards, and the best ergonomic applications. It is important to carefully analyze the product to determine if any hazards associated with the product exist as well as anticipate both the intended and unintended uses of the product. The design of warnings can and should be viewed as an integral part of the design system. Warnings cannot and should not be expected to serve as a cure for bad design. Generally, the strategy that is used to produce a safe product involves the following steps:

- Remove the hazard.
- Limit access to the hazard.
- Inform the user of the hazard by using labeling and instruction manuals.
- Train the user to avoid the hazard.

If satisfaction is not achieved either through the elimination or minimization of the hazard, the remaining choice is to either design to mitigate the hazard or completely ban the product, which requires federal government involvement. All warning labels should accomplish three things:

1. Get the user's attention.
2. Describe the danger in clear terms.
3. Give specific instructions on how to avoid any injury from using the product.

Typically, seven steps are used when designing warning signs or labels and they are summarized in the following:

1. Specifically define
   a. The risk or hazard
   b. The consequences of exposure to the hazard
   c. The audience or receiver of the message
   d. How to avoid the hazard

2. Determine and evalua
3. Draft the wording
4. Evaluate the wording
   counsel.
5. Perform user testing, ev
   a. Was the message n
   b. Was the message u
   c. Was avoidance beh
6. Revise the warning ba
7. Retest the warning if n

There are eight criteria that a
and they include the followin

- Attention
  - Warnings should be
- Hazard information
  - Warnings should co
- Consequence informati
  - Warnings should co
- Instructions
  - Warnings should in
- Comprehension
  - Warnings should be
- Motivation
  - Warnings should m
- Brevity
  - Warnings should be
- Durability
  - Warnings should las

There are several dimensions
design of warnings. For exam
some special target audience t
would not be able to receive a
receive an auditory warning. T
cognitive competence and are

- Technical knowledge
  - The communication
    cals, and mechanical
  - If the target audience
    may not be successfu
- Language
  - There are several subg
    languages other than

2. Determine and evaluate the best method to communicate the message.
3. Draft the wording.
4. Evaluate the wording by using a communication specialist and legal counsel.
5. Perform user testing, evaluating results with established pass-fail criteria.
   a. Was the message noticed?
   b. Was the message understood?
   c. Was avoidance behavior correctly carried out by the users?
6. Revise the warning based on the results of user testing.
7. Retest the warning if it is necessary. Finally, print and distribute.

There are eight criteria that are quite useful in the design and assessment of warnings and they include the following:

- Attention
  - Warnings should be designed so as to attract attention.
- Hazard information
  - Warnings should contain information about the potential outcomes.
- Consequence information
  - Warnings should contain information about the potential outcomes.
- Instructions
  - Warnings should instruct about appropriate and inappropriate behaviors.
- Comprehension
  - Warnings should be understood by the target audience.
- Motivation
  - Warnings should motivate people to comply.
- Brevity
  - Warnings should be as brief as possible.
- Durability
  - Warnings should last and be available as long as needed.

There are several dimensions of receiver competence that may be relevant to the design of warnings. For example, sensory deficits might be a factor in the ability of some special target audience to be directly influenced by a warning. A blind person would not be able to receive a written warning nor would a deaf person be able to receive an auditory warning. There are three characteristics of receivers that relate to cognitive competence and are important in the design of warnings:

- Technical knowledge
  - The communication of hazards associated with medications, chemicals, and mechanical devices.
  - If the target audience does not have technical competence, the warning may not be successful.
- Language
  - There are several subgroups in the American society who speak and read languages other than English. As trade becomes more international,

requirements for warnings to be directed to non-English readers will increase.
    - Solutions to this problem include designing warnings that are stated in multiple languages and the use of pictorials or graphics.
- Reading ability
    - The general recommendation for common target audiences is that the reading level be in the grade 4–6 range.
    - An important point on reading ability deals with illiteracy. There are about 16 million functionally illiterate adults in the American population. Therefore, successful communication of warnings may require more than simply keeping reading levels to a minimum.
    - Use pictorials or graphics to supplement text.

10.6 SUMMARY

As technology shortens the product development life cycle, it will become increasingly more important to integrate ergonomics in product development, testing, and safety communication. The principles of warning and communication of product information should be adhered to throughout product development as the application of human factors and ergonomics knowledge in the design of consumer products, warnings, and instructions has proven useful in reducing risk of incidents.

Case Study

FDA Orders Easy-to-Understand Warnings for Prescription Drugs

February 9, 2004

By *Jeanie Croasmun*

In an attempt to make prescription drug warnings more readily understandable by consumers, decision-makers at the FDA last week ordered prescription drug manufacturers to start following new guidelines that should make the fine-print of prescription ads more consumer-friendly. In other words, warning labels should be more ergonomic.

Honing in on the fine print of prescription-drug print ads and the difficulties consumers may have reading and understanding any associated warnings, the FDA's new guidelines recommend the following:

- Lay terms rather than medical jargon in warnings so a potential user of the prescription drug can comprehend the list of possible side-effects.
- A reorganization of ads to put the most common risks and potentially lifesaving information at the beginning of the ad's warning statements.

- Bigger font sizes for
- Relocation of the
rather than behind it.

The motivation behind the
both read and understand.
Patients do not read the
guidance given is often

The FDA also believes
smaller (and less expensive
consumer understanding."
explaining that a smaller
on the reader than just

Critics of the guidelines
to warnings that are too
D-California, told CNN
ment previously reading
with "can affect liver

While providing
component of ergonomics,
regard to user understanding
Traffic Safety Administration
dard set of dashboard
determined that in tests,
to the warnings. Ironically,
ing lights was to develop

Sources: Reprinted
CNN.com; Ergonomics

EXERCISES

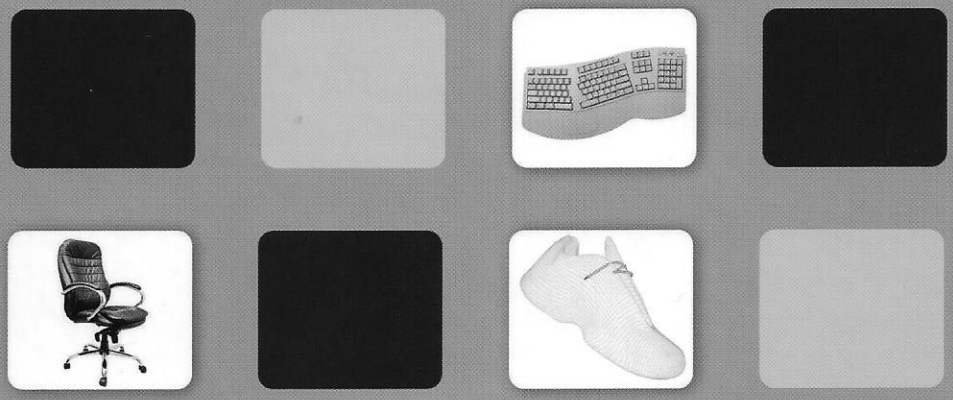
10.1 Explain the four
perspective.

10.2 What have been some
product liability cases?

10.3 Identify the branch of
responsible for consumer
an overview of the
guidelines.

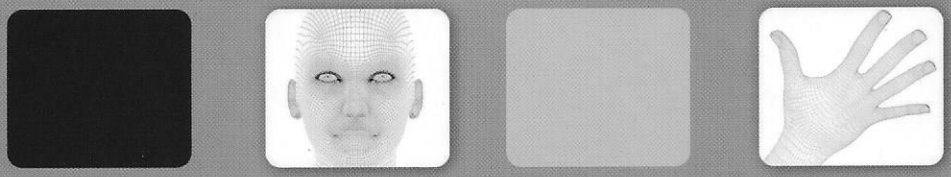
10.4 Discuss the types of
example where each

10.5 Design a warning
(i.e., Wii game)



ERGONOMICS

Foundational Principles, Applications, and Technologies



Pamela McCauley Bush, PhD, CPE

CRC Press
Taylor & Francis Group