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INCREASING ATTENTION TO AND RETENTION OF WARNINGS:
THE EFFECTS OF CONTAINER HAZARDOUSNESS, WARNING QUALITY, AND
SEVERITY OF INJURY

by

MELISSA E. MEINGAST

A THESIS SUBMITTED
IN PARTIAL FULFILLMENT OF THE
REQUIREMENTS FOR THE DEGREE

Master of Arts

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ABSTRACT

INCREASING ATTENTION TO AND RETENTION OF WARNINGS: EFFECTS OF CONTAINER HAZARDOUSNESS, WARNING QUALITY, AND SEVERITY OF INJURY

By

MELISSA E. MEINGAST

This research examined the influence of warning quality, container hazardousness, and severity of the potential injury on attention to and retention of warning information. Warning quality and container hazardousness were manipulated as within subjects variables, severity of injury as a between subjects variable. Two levels of each variable were used, high and low. Participants viewed the four possible combinations of warning quality and container hazardousness and then responded to various questions concerning their perceptions and retention of warning information. The results demonstrated the importance of warning quality. Enhanced features such as pictorials, signal words, safety icons, and color increase warning salience and recollection of warning information. The results also indicate that the hazardousness of containers influences whether people read warning labels and subsequent reports of cautious intent. However, its influence is modified by both severity of injury and warning quality.

ACKNOWLEDGEMENTS

I would like to thank all the members of my committee, past and present, including Kenneth Laughery, John Brelsford, David Lane, and Miguel Quiñones for their invaluable advice and assistance throughout this research process. Thanks also to Mike Wogalter for initiating this line of research and for sharing both advice and materials. I would also like to extend my deepest gratitude to all the people at Cal Data Systems, Inc. for their generosity in assisting with all the phases of this research, from the printing to participating as subjects in numerous pilot studies. Mom and Dad, thank you for believing in me and listening to me through all the ups and downs. Finally, thanks to Mike Lewis; without your assistance, understanding, and patience this would not have been possible.

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INTRODUCTION

Hazards are everywhere. Driving a car, taking over the counter medication, and cleaning the drain of a sink are all activities that can be perceived as hazardous. But what does it mean to refer to something as hazardous? The term hazard is generally used to refer to an activity or object that has potential to produce damage or destruction to a person and/or property. The term hazardousness, therefore, is used to refer to a product's or activity's likelihood of producing damage or injury. While the hazard of large scale technological devices such as nuclear power are rather dramatic and often receive media attention, the hazards that are the focus of this research are those that individuals encounter everyday: consumer products.

When certain consumer products are ingested, inhaled, contacted with skin or eyes, or used in enclosed spaces severe injury and sometimes even death can result. It is this quality that causes some of these products to be considered hazardous (Wogalter, Laughery, & Barfield, 1997). For example, products such as pesticides, turpentine, and drain cleaner are considered hazardous because each has the potential to cause severe injury and are potentially fatal if used improperly. A consumer who uses these items, however, may not perceive them as hazardous.

Unlike the blades of a saw, the potential for harm is not always apparent by simply looking at a product or observing its function. This distinction refers to the open and obviousness of the product hazard: while the hazards associated with the blades of a saw are readily determined simply by viewing the product, those associated with various chemical products cannot be determined simply by looking at them.

As pointed out by Ryan (1987), research on hazard recognition indicates that a large percentage of consumer products contain latent hazards that are not recognized until after the consumer is injured. In addition, hazards that appear open and obvious to one user may not be noticed by another. Laughery (1993) noted that product users may not share similar knowledge and or presumptions regarding the hazards related to product use. Therefore, it should not be assumed that a hazard is open and obvious without empirical evidence. In addition, even if users are aware of the hazard inherent in the product, they may not be aware of the behaviors necessary to ensure the safe use of the product.

One means of disseminating information concerning safe product use to the public is through warning labels and instructions. In many cases, the use of warnings is not only recommended, it is legally required. Cunitz (1992, as cited in McCarthy, Ayers, & Wood, 1995) states that legally a warning must be provided whenever, “known or knowable hazards exist in a product or situation and it is foreseeable that people will be at risk, i. e., exposed to the hazards” (p. 2165). However, as anyone who has ever used a consumer product knows, people do not always take the time to read warning labels and instructions.

One factor that has been found to consistently impact individuals’ “cautious intent”, or their willingness to engage in safety behaviors such as reading labels, are users’ perceptions of products’ level of hazardousness (DeJoy, 1989). Further, one aspect that has been found to influence perceived product hazardousness is product packaging (Wogalter, Laughery, & Barfield, 1997). Meingast (1998c) found that

consumer's perceptions of the level of hazard represented by certain packaging designs is due almost entirely to their prior experience and knowledge concerning the types of products that are typically found in such containers. In addition, the severity of the potential injury that a product can cause is closely linked to the perceived hazardousness of the product. Yet while these factors may interact to influence consumer's perceptions of hazard and cause them to seek out warning information, this information is not always presented in a fashion where it is easily noticed and/or understood by the average consumer. This research was designed to explore these issues. However, before the current research is discussed an overview of prior research in these areas is in order.

Perceived Hazardousness and Cautious Intent

One of the first steps in designing an effective warning from the physical standpoint is to ensure that it attracts consumers' attention, however, this alone is not enough. In order for a warning to serve its purpose, individuals must also read the warning. DeJoy (1989) critically reviewed forty research articles published between 1984 and 1988 that dealt with the effectiveness of consumer product warnings. Among his many findings was the fact that even when individuals notice a product warning, they do not always take the time to read it. Additional researchers have found similar effects. Freidmann (1988) looked at the use of two types of consumer products, wood cleaner and liquid drain opener, by 144 college students. She found that across product types, while 88% of students noticed the product warning, only 46% actually read the warning. Similarly, Otsubo (1988) looked at various factors thought to influence consumer safety

behavior. She found that while 64% of participants noticed warnings on the two products used, a circular saw and a jig saw, only 39% proceeded to read the warnings.

In light of such findings it is not surprising that a primary concern of individuals involved in the study of consumer safety product is the investigation of the factors that increase cautionary intent, encouraging safety behaviors such as reading warning labels. One variable that has received a great deal of attention in this arena is the perceived hazardousness of the product.

Consumers' perceptions of the level of hazardousness associated with the use of everyday products have been found to influence cautious intent in a number of ways. For example, the two varieties of saws used in the Otsubo (1988) study represented two levels of hazard. She found that significantly more people noticed, read, and complied with the warning placed on the circular saw, which was perceived to be relatively more hazardous, than did with the jigsaw, which was perceived to be relatively less hazardous. Based on these findings she concluded that, "these products were perceived differently, and it is likely that this perceived difference in 'danger' or 'hazard' affected warning effectiveness" (p. 539). Otsubo's research is limited, however, in that her investigation of the influence of hazard perceptions was only in relation to one specific product type.

Consumers' hazard perceptions for a wider variety of products were investigated by Wogalter, Desaulniers, and Brelsford (1986). They examined consumers' impressions of the hazardousness of a variety of electrical products, chemical products, and non-electrical tools, and the influence these perceptions had on willingness to read product warnings. They found that perceived product hazardousness accounted for eighty percent

of individuals' reported willingness to read a warning. Indeed, Wogalter et al. (1986) concluded, "perceived product hazardousness is the primary determinant of reported willingness to read warnings" (p. 1200). This strong, positive relationship between reported willingness to read a warning and perceived product hazardousness has also been found by Friedmann (1988), Silver, Leonard, Ponsi, and Wogalter (1991), and Wogalter, Brelsford, Desaulniers, and Laughery (1991).

Wogalter, Desaulniers, and Brelsford (1987) expanded on findings concerning the relationship between perceived hazardousness and cautious intent to include additional precautionary behaviors. Participants rated a list of 18 consumer products, ranging from an aerosol insecticide to a semi-automatic rifle, on a variety of dimensions. These dimensions included the degree of precautionary intent the participant felt they would take when using the product and the overall perceived hazardousness of the product. They found that the perceived hazard of a product was positively correlated with both individuals' reports of the injury preventing behaviors they would engage in when using the product and willingness to read the product warning.

An additional effect of perceived hazardousness was noted by LaRue and Cohen (1987), who found that consumers expect to find warnings on products they perceive to be hazardous. Such findings are encouraging, in the sense that taken together, they imply that consumers are more willing to read warnings on the types of hazardous products that typically have warnings and require specific safety behavior. One problem, however, lies in the additional implication, as pointed out by Wogalter et al. (1986), that "people may fail to read warnings because they misjudge the hazardousness of the product" (p. 1201).

So how do consumers form perceptions of products as being hazardous or benign? As pointed out by Wogalter et al (1987), the answer to this question is critical in the prevention of consumer product accidents and the development of effective interventions. People exercise greater caution with products they perceive as hazardous, and they are more likely in such instances to take advantage of safety information. Two factors that have been found to impact user's perceptions of the hazardousness of various consumer products are familiarity with the particular type of product, and the severity of the injury that might result from product use (Vaubel & Young, 1992).

Product Familiarity

In a study concerning the labeling of products containing methylene chloride Pollack-Nelson (1995) found that the extent to which warning information was read differed between the three products looked at: spray paint, paint stripper, and adhesive remover. While more than two-third of the users of paint stripper and adhesive remover reported to have at least skimmed the product instructions and warnings, only half of the spray-paint users reported these behaviors. Pollack-Nelson concluded that this difference in precautionary behavior was likely due to product familiarity; spray paint is more familiar and easier to use than adhesive remover and paint stripper.

It appears that increased product familiarity reduces cautious intent, however, Godfrey, Allender, Laughery, and Smith (1983) found that while familiarity with a product negatively influenced willingness to look for a warning label on products rated as less hazardous, it had no effect on cautionary intent for highly hazardous products such as

pesticides. Furthermore, they found that products reported as familiar were described as less hazardous than unfamiliar products.

The inverse relationship between familiarity and cautious intent can lead to potentially negative consequences in some situations. In a study exploring women's knowledge of Toxic Shock Syndrome resulting from tampon use, Godfrey and Laughery (1984) found that women were more likely to notice a warnings when first using tampons than if they switch brands or to a more absorbent product from the same manufacturer. Based on their finding, Godfrey and Laughery (1984) concluded that women's familiarity with a specific product or a product that appears similar to a familiar product led to a decrease in the perceived hazardousness of the product. Not surprisingly, women did not notice warnings on products that appeared similar to products that they had used in the past. This may mean that when a consumer switches to a product that resembles a familiar product, but in reality is more hazardous, the consumer will be less likely to notice warnings and take proper precautions than if the product was novel. Indeed, Wright, Creighton, and Trealfall (1982) found that people claimed to be less likely to read the instructions for products that they used frequently.

While product familiarity appears to modify the relationship between perceived hazardousness and cautious intent, researchers have questioned the validity of product familiarity as a critical predictor of cautionary intent. Wogalter et al (1986) found that while product familiarity is significantly related to reported willingness to read warnings, it provides little predictive value beyond hazardousness. Familiarity with products influences how they are perceived, however, it is the perception of hazardousness that is

the critical factor in shaping cautious intent. So what factors shape perceptions of hazardousness?

Severity and Likelihood of Injury

Additional research by Wogalter et al (1987) further examined the components involved in the formation of perceptions of hazardousness of consumer products. Participants rated 72 consumer products on perceived hazardousness, expected severity of injury, and perceived likelihood of injury. A strong, positive relationship was found between ratings of hazardousness and the severity of injury. The likelihood of injury was also positively correlated to perceptions of hazardousness, although to a lesser extent. Product familiarity, however, did not aid in predictions of perceived product hazardousness beyond the contributions of injury severity and likelihood. In addition, subsequent analysis indicted that adding likelihood of injury to a regression model did not aid in predictions of hazardousness beyond severity of injury. Wogalter et al. (1987) concluded that the single best predictor of hazard perception is severity of injury.

A follow up study conducted by Young, Wogalter, and Brelsford (1992) produced similar results. The single best predictor of the perceived hazardousness for a list of 85 consumer products was the severity of the potential injury associated with product use. This variable accounted for 91.8% of the variance in hazard ratings. They concluded that there was “no evidence to suggest that likelihood plays a part in people’s perceptions of these products” (p. 263). For everyday consumer products, the attribute most predictive of perceived hazardousness is severity of injury.

It is obvious that consumers' awareness of the severity of potential injuries they could sustain from unsafe product use influence whether or not the product is perceived as a hazard. However, what then happens when individuals are unfamiliar with a product and therefore lack knowledge concerning the severity of potential injuries that could result from product use? One means of conveying the severity of the injuries potentially associated with consumer product use is through warnings. However, as discussed previously, this is a sort of Catch-22. People are more likely to look for and read on-product warnings if the product is perceived as capable of producing a relatively severe injury, and therefore is perceived as hazardous. But what if these judgements are incorrect?

This problem is particularly visible with over the counter consumer chemical products. The severity of the potential injury that could result from the unsafe use of these products is typically not open and obvious, and people may not correctly understand the level of the latent hazard they are dealing with. If initial impressions of the product hazard are incorrect warnings may not be read. This incorrect perception may not change until an injury occurs. One product attribute that has recently received attention as a means of making the level of hazardousness associated with packaged consumer products more obvious is the packaging itself (Wogalter, Laughery, & Barfield, 1997).

Packaging allows manufactures and retailers to place warnings on consumer products to disseminate safety information. Printed warnings, when read, have the potential themselves to impact perceptions of product hazardousness and encourage the

adoption of appropriate behaviors for safe product use. But what about the non-textual cues containers provide, such as their shape and color? As discussed previously, DeJoy (1989) found that not all consumers who notice warnings actually read them. It may be that a non-textual medium could be used to conveying the hazardous nature of chemical products and encourage cautionary intent. Such instruments include characteristics of the product packaging such as shape and color. These attributes may provide cues as to the level of product hazard and draw attention to warning information (Wogalter et al., 1997). While this issue has not received a great deal of direct attention in the safety literature, there is a great deal of research on visual warnings that indicates that the components of shape and color often play a role in individual's perceptions of the level of hazard associated with various warnings.

Warning Shape and Color

Three factors that have received a great deal of attention in research concerning the physical properties of product warnings are the shape, color, and location of these warnings. An examination of 19 different geometric warning label shapes conducted by Riley, Cochran, and Ballard (1982) revealed that individuals do indeed discriminate between different warning labels shapes. The most preferred shape for a warning indicator was a triangle on its vertex, outranking shapes such as octagons, trapezoids, and rectangles. Shapes with harder edges, such as squares, were found to cue greater hazard associations than more rounded shapes. Collins (1983), in an investigation of mine safety symbols, found that octagonal and diamond shapes were judged to be more indicative of hazard than square and circular shapes.

Different warning shapes are able to convey different levels of hazard. Further, research has shown that differences in the rates of compliance to various warnings are influenced by the shape of the warnings. Rodriguez (1991) evaluated the effect of several warning attributes, including shape, on compliance rates. Three different shapes were used as warning label borders; octagon, triangle, and neutral. The neutral shape condition was simply a warning that was not contained by a border. A significant main effect was found for shape in terms of participants' level of compliance with warning information: warnings that were enclosed by a shape resulted in significantly higher compliance rates than those that were not, and octagonal shapes produced slightly higher compliance than triangular enclosures.

Findings concerning the influence of warning shape on compliance rates, however, are equivocal at best. Jaynes and Boles (1990) investigated the relationship between warning designs and compliance rates. They discovered that the use of a triangular versus a circular warning enclosure did not influence the rate at which subjects adhered to warning information.

The results of research concerning the effects of color in communicating level of hazard and attracting attention have been more definitive. Kline, Braun, Peterson, and Silver (1993) employed both achromatic and colored versions of consumer product labels. They found that labels printed in color were significantly more attention demanding than equivalent black and white labels.

Not only is color a successful tool in attracting attention to warning labels; it has also been found to assist in the communication of hazard information. Chapanis (1994)

asked individuals to rate the arousal strength or impact of various colors. The color red was found to have the highest arousal strength, followed by orange and yellow. White was rated as possessing the weakest arousal strength. In addition, Chapanis (1994) found a strong association between the word "DANGER" and the color red. Braun and Silver (1995) found that when participants evaluated the strength of the warning conveyed by various colored warnings the perceived hazard associated with the color red was significantly higher than for the four other colors tested (orange, green, blue, and black). In addition, orange was perceived to represent a significantly greater hazard than the colors blue, green, and black: these colors did not vary significantly from one another in the strength of the warning conveyed. Similarly, Bresnahan and Bryk (1975) found that accident prevention signs printed in red produced the highest associated hazard ratings, followed by yellow, green, and blue, respectively.

The level of hazard conveyed by various colors has been found to be relatively universal (Dunlap, Granda, & Kustas, 1986, as cited in Braun & Silver, 1995). A survey of 1169 people across several language groups found a consistent pattern in the hazard information communicated by different colors. Red received the highest hazard rating, followed respectively by orange, yellow, blue, green, and white. This pattern was constant across language groups with the exception of the color yellow.

Standards regarding the use of color in warning signs are generally consistent with empirical evidence. Westinghouse (1981) recommends the pairing of the color red with the word "DANGER", orange with "WARNING", and yellow with "CAUTION". ANSI standard Z535.4 (1991) recommends similar combinations.

Color has also been found to influence individual behavior and performance (Braun & Silver, 1995; Christ, 1975; Edworthy & Warren, 1997). Christ (1975) reviewed 42 studies focused on the effects of color on visual search and identification task performance. He found that for some types of tasks that use of color increased performance and in other conditions the incorporation of color resulted in a performance decrement.

Specific colors also influence willingness to comply with warnings. Edworthy and Warren (1997) conducted a study in which they presented children with 18 different warning signs. The signs involved combinations of three signal words: DANGER, CAREFUL, WARNING; and six background colors: red, orange, yellow, blue, green, white. The children rank ordered the signs by selecting them one at a time, starting with the warning sign that they felt was the most important to obey. The researchers found that color had a significant overall effect. The color red was selected very early on, while the white signs were always selected near the end. Braun and Silver (1995) found that signs printed in red resulted in greater compliance rates than those printed in black or green.

Such finding clearly demonstrate that color can be a very useful tool in conveying hazard information. People associate various colors with specific levels of hazard, and the perceived hazardousness of various products has been shown to influence willingness to engage in cautionary behavior. Therefore, color has often been employed as a redundant coding variable to convey hazard information and encourage cautious intent.

Shape and Color's Combined Effects

The relationship between color and shape in their ability to convey hazard information however, is not as straightforward as that between signal word and color. Easterby and Hakiel (1977a, as cited in Riley et al., 1982) found that shape and color function independently of each other as coding variables. They also found that the shape and form of an image on a sign, independent of its color, was the most critical influence on performance (Easterby & Hakiel, 1977b, as cited in Riley et al., 1982). Rodriguez (1991), however, concluded that specific color and shape combinations are differentially effective in attracting consumers' attention. To date finding on the nature of the relationship between the combined ability of shape and color to convey hazard information remains equivocal.

Container Shape and Color

The investigation of the relationship between physical attributes such as shape and color on perceived hazardousness has focused largely on characteristics of warning signs. However, researchers have speculated that the shape and color of the containers that consumer products are packaged in may also serve as cues as to the nature of the hazard contained within.

Concerned with the prevention of accidental poisoning of children, Schneider (1977) investigated children's attraction to containers as a function of a variety of label and package characteristics, including container shape and color. Round, square, and triangular containers were presented in the colors red, black, and white. The children who participated in the study ranged in age from 3.5 to 5.5 years of age. Schneider found

that a greater number of children were attracted to white containers, followed by black and red respectively. He did not find a statistically significant difference between the various container shapes, although he did find that children were slightly more attracted to the square container.

Wogalter, Laughery, and Barfield (1997) reviewed Schneider's research and concluded that the failure to find significant differences in attraction to the various container shapes might be due to the simple shapes used or the relatively small sample size. They investigated the relation ship between perceived hazardousness and container shape by asking participants to judge pictures of 17 different container configurations on several different dimensions. These dimensions included perceived hazardousness, willingness to read the label, and familiarity. Wogalter et al. (1997) found that individuals' perceptions of container shapes did in fact influence judgements of perceived hazard. Additionally, participants' reports of their likelihood of reading the label on each of the various containers were highly correlated to the perceived hazardousness of the container. Further investigation of the specific shapes that consistently received high or low hazard ratings led Wogalter et al. concluded that hazard 'perceptions, whether correct or incorrect, are probably based on previous experience with known products in similar containers" (p.393).

Product packaging features such as shape have the potential to convey information about the hazardousness of their contents. As researchers such as Wogalter et al. (1997) have pointed out, it is therefore extremely important to place products in containers that accurately reflect their level of hazard. This sentiment is echoed by

Rhoades (1990). He analyzed several accident case studies and noted that the knowledge people apply when using a product comes from a variety of sources in addition to the printed information that exists on the product. One of these sources of information involves the physical features of the product, as well as the user's prior experience with similar products. He therefore concluded that "if constraints require an extremely flammable product to be packaged in a container typically used to package paint, then product safety information must overcome the false knowledge that might be initiated by the 'paint can' shape of the container" (p. 1001).

Container shapes have the ability to convey hazard information, predominately due to users' past experience with similar containers and their contents. The relationship between container shape and color as redundant hazard cues, however, is not as promising. In a study conducted by Meingast (1998 a) six different container shapes taken from the Wogalter et al. (1997) study, representing three different levels of perceived hazardousness (2 high, 2 medium, and 2 low) were combined with six different colors (red, orange, yellow, blue, green, and white). Participants were asked to rank order the pictures of the 36 containers based on the level of hazard conveyed. The results indicated that participants did discriminate between the level of hazard conveyed by each container type. Color was used to make finer discriminations within container type. That is, all of the high hazard containers were ranked in the top twelve in terms of level of hazard conveyed, and within a container type the red container received a higher hazardousness ranking than the orange container, which received a higher hazardousness ranking than the yellow container, and so on. These results were rather disappointing,

however, in that participants, once they had selected a particular container shape as representing a specific level of hazard, simply appeared to rely on color heuristics and ranked the various containers without taking any time to really discriminate between them (all participants completed the ranking task for all 36 containers in under three minutes).

A subsequent study was therefore conducted using only three container shapes representing high, medium, and low hazard, and three levels of color: red, representing high hazard, black, representing moderate hazard, and white, representing low hazard. The number of stimuli was reduced in an attempt to encourage participants to spend more time focusing on the individual containers. In addition, actual three-dimensional containers, as opposed to two-dimensional sketches, were used as stimuli. Once again, shape appeared to dominate the ranking process, with color being used to make finer discriminations. The red, high hazard shape was always selected as representing the highest level of hazardousness, followed by the black high hazard shape, then the white high hazard shapes. Next in the rankings came the moderate hazard shape, following the same pattern for color, and so on with the white low hazard container receiving the lowest ranking. However, while participants did use color to make finer discriminations when forced by a rank ordering task, color was not used as a cue in a rating task. The three container shapes were significantly different in level of perceived hazardousness, and no effect was found for color.

Based on these findings, Meingast (1998 b) concluded that while people can use color as a cue to discriminate the level of hazard associated with a particular container

type if forced by a task such as rank ordering, in actuality, when simply comparing containers, it does not provide any meaningful information. This may be due to the fact that container color is motivated by marketing concerns and brand affiliation and is not selected based on its ability to convey hazard information. For example, laundry detergent can be found in packages ranging in color from white to red to yellow to blue. When asked which product they buy the standard reply of many individuals is “I buy the detergent in the blue (red) container”. These products are all equivalent in the level of hazard associated with them. Color is used to help consumers distinguish between various brands of products and to make the packaging attractive rather than convey meaningful safety information. Consumers do not appear to generalize the pre-existing schemas they possess concerning warning colors and the level of related hazard to containers.

A follow up study was done in which participants viewed 12 containers that differed on a variety of dimensions such as shape, size, material, type of lid, and color (Meingast, 1998c). Participants were also asked to sketch what they felt would be the best container to put an extremely hazardous product in. The purpose of the study was to determine exactly which physical properties of containers beyond shape are attended to when consumers making hazard judgments.

On a scale of zero to four, with four indicating that the item was extremely important in forming hazard perceptions, and zero indicating that the item was not at all important in forming these perceptions, 25 out of 26 subjects rated past experience with a particular type of container as a four, indicating that it was extremely important in

determining level of hazard. The only other container attributes that received ratings over 2 were shape, type of lid, and material the container was made out of. These items are all highly related, however, due to the fact that the shape of the container typically dictates the type of lid, as well as the type of material that the container is composed of.

This is exactly what participants in the study said when explaining their ratings, indicating that the overall appearance of the container type was what they felt they felt was most critical in terms of making hazard judgments, rather than anyone specific element. Participants were also asked to sketch a container that they would use to house a highly hazardous product. What is interesting is that although a range of containers were sketched, 30% of participants drew a container with a warning on it, although no reference to warnings had been made at any time during the experiment. The presence of a warning in and of itself was used as a cue to indicate that the product within might be hazardous and should be used with caution.

While there appears to be a link between the level of hazard conveyed by container features and consumers' perceptions of the need for warnings, there is little research concerning the relationship between the perceived hazardousness of product packaging and precautionary intent. In addition, the relationship between the level of hazard conveyed by product packaging and warning effectiveness might not be as straightforward as it appears on the surface. One reason involves the issue of compatibility.

Compatibility

Compatibility, as originally defined by Fitts and Seeger (1953), refers to the degree to which a stimulus and its required response conform to human expectations. Human expectations concerning compatible and incompatible relationships are typically acquired in two ways (Sanders & McCormick, 1993). First, some of these relationships are inherent to the situation. An example of a compatible relationship that is inherent to the situation is moving a computer mouse to the right in order to move the cursor to the right. Second, some of these relationships are culturally acquired. For example, the association of red traffic signs indicating stop. While several types of compatibility have been identified and investigated by researches, the compatibility issue that presents itself when considering hazards does not clearly fit into these categories.

Approaching product design from a compatibility standpoint, the container itself and the printed material upon it can be seen as having either a compatible or an incompatible relationship. Specifically, previous pilot research has shown that containers convey a certain level of hazard through associations people have gained through prior experience with these containers. In terms of the two means of acquiring information concerning compatibility described previously, the association of containers with certain levels of hazard is acquired through cultural means.

Textual information presented in product warnings also, and in a much more direct manner, conveys a certain level of hazard. Certain product warnings inform the user that the product could kill them if used improperly, while others warn of potential irritation or inconvenience. Therefore, the level of hazard described in a product's

warning can be viewed as being either compatible or incompatible with the level of hazard conveyed by the product's packaging.

Previous research on stimulus response compatibility has found that people tend to perform better when the stimuli and the response are compatible. This may also be the case with containers and warnings. That is, if performance is measured in terms of remembering and/or obeying a product warning, it may be that people are better able to remember the information contained in a package warning when the level of hazard conveyed by the packaging is compatible with the level of hazard conveyed by the warning.

It is also possible, however, that the opposite effect may occur. Friedman (1979) found what could be termed a novelty effect. Friedman (1979) presented participants with line drawings of various scenes for which there were salient schemas, such as a kitchen. Objects portrayed in each scene were classified as high, medium, and low likelihood. Friedman had participants view the scenes, and recorded their eye fixations. She found that low likelihood, unexpected objects, received greater exploration and attention than high likelihood objects in the initial viewing period.

This effect may also be found with containers and their labels. For example, it may be that, once noticed, a low hazard warning on a high hazard container is seen as incompatible, and novel. Consumers may therefore devote greater attention to incompatible warnings, and this increased attention may result in heightened recall of information from incompatible rather than compatible warnings.

Warning Quality

An additional factor that may interact with the level of hazard conveyed by the container and subsequent precautionary intent, such as reading a warning, is the quality of the warning itself. Numerous standards and guidelines exist concerning warning design (e.g. ANSI, 1991; FMC, 1980; Westinghouse, 1981). The criteria specified in these standards can generally be grouped into two categories: content and format.

Content refers to the meaning of the message and the wording used to express this message. Young (1992) states that recommended content for warnings involves:

- 1) A signal word, such as "HAZARD" or "DANGER"
- 2) A hazard statement telling what the dangers are
- 3) A consequence statement emphasizing what will happen if the warning is not heeded
- 4) Instructions indicating how the hazard may be avoided

Wogalter, Godfrey, Fontenelle, Desaulniers, Rothstein, and Laughery (1987) found that the removal of any one of these content variables significantly reduced the perceived effectiveness of warning signs. In addition, the removal of the hazard statements from warning signs resulted in the greatest decrease in perceived effectiveness. This is consistent with their finding that the hazard statement is seen as providing more information than any other content variable. Additional studies by Wogalter, Jarrard, and Simpson (1994) found that the presence of a signal word increased perceived product hazardousness as compared to conditions where no signal word was present.

Format, on the other hand, involves the different methods that can be used to draw attention to and deliver the contents of the warning message. Format involves components such as pictorials, borders, shape, lettering, layout, color, etc. These are the issues addressed by the ANSI Z535.4 (1991) standard. As pointed out by Young (1992):

“Even though it is the content that ultimately determines the effectiveness of a warning, aspects of the format are fundamentally important in ensuring that the content is noticed and read by the target. Intuitively, format is important for the simple reason that if the warning is not noticed and read the quality or property of the content is irrelevant”(p.1).

Yet formatting variables are not just a means of attracting attention, they also convey information. The effectiveness of color in attracting attention and influencing hazard perceptions has already been discussed. In turn, some research has found that the influence of color on perceived hazardousness has behavioral implications. For example, research by Braun and Silver (1995) found that warnings printed in red result in a higher proportion of compliant behavior than those printed in green or black combined. Another formatting variable that has the ability not only to attract attention but also to convey information is a pictorial.

Most warning design guidelines and standards recommend the use of graphical symbols such as pictorials (ANSI, 1991; FMC, 1980; Westinghouse, 1981). Not only do well-designed pictorials attract attention to printed warning information (Freidmann, 1988; Otsubo, 1988), they also quickly communicate hazard information. Dorris and

Purswell (1978) suggested that pictorials are more rapidly recognized and more effective at conveying hazard information than simple verbal warning messages.

Young and Wogalter (1990) conducted two experiments investigating the effects of increased conspicuity of printed text and the presence of pictorial icons on comprehension and memory of warnings. Participants reviewed a manual for either a gas-powered electric generator or a natural gas oven. Four different versions of each instruction manual existed, based on the type of warning included: (1) conspicuous print, pictorials present, (2) conspicuous print, pictorial absent, (3) plain print, pictorials present, and (4) plain print, pictorials absent. Comprehension and memory of warning information were significantly greater for the conspicuous print, pictorial present condition as compared to the other three conditions. It should be noted that although the addition of conspicuous print resulted in increased recall, its impact on memory was not as great as that of pictorials.

Not only does the addition of pictorials augment retention of warning information, their inclusion has also been found to influence compliance with warning information. Jaynes and Boles (1990), in an examination of five different warning label types, found that adding a pictograph to a textual warning increased compliance when compared to text only warnings. Research concerning the effectiveness of pictograms, however, is ambiguous. Researchers such as Otsubo (1988) have found no difference in compliance between warning labels with words only, pictographs only, and word and pictographs.

The influence pictorials paired with written warnings have on recall may be due to the fact that the pictorials serve as a redundant cue. Pavio, Rogers, and Smythe (1968)

found that pictures are easier to recall than words. If an individual is able to recall the pictorial, this may then serve as a trigger in recalling the textual information. Wickens (1992) wrote that communication via pictorial and textual combinations facilitates information processing. This is accomplished through the use of redundant coding, which allows people to capitalize on the information extraction method (spatial or semantic) that they process best, allowing for improved recall. Using two types of warning stimuli, such as a pictorial and a word, may cause individuals to utilize two different coding systems involving both brain hemispheres, and this dual coding should promote greater recall that is resistant to decay (Pavio, 1975, as cited in Wogalter, Sojourner, & Brelsford, 1997). Hence the effectiveness of combined textual and pictorial warning configurations.

Factors that influence individual's memory of a warning are extremely important. People do not refer to the warning each time that they use a product; instead it is often the case that the only time a product warning is read is on the first occasion of use. It is at this time that consumers tend to seek information about product use, including safety concerns. Factors that lead to improved recall of warning information on latter occasions are therefore extremely important.

Despite such concerns, most research on pictorials has focused on people's ability to identify various pictorials rather than the influence pictorials may have on memory and behavior (e.g. Collins, Lerner, & Pierman, 1982, Mayer & Laux, 1989; Wolff & Wogalter, 1998). Furthermore, the majority of research on warning efficacy has focused on the open and obvious hazards of machinery and equipment such as saws, ovens,

generators, copying machines, etc. Therefore, very little is known about how warning attributes interact with the features of the containers they are placed on in influencing attention and retention of information related to the safe use of consumer chemical products.

This study was designed to address these issues, namely:

1. Are consumer product labels that adhere to the ANSI 235 product warning guidelines, thereby including color, pictorials, and text, more effective in attracting individual's attention and subsequent retention of the informational content of the warning than warnings that simply contain text?
2. Does the perceived hazardousness of a container influence the likelihood that a user will attend to a warning and recall the informational content?
3. Does the severity of the possible injury described in a warning influence individual recall of warning information?
4. Does the compatibility of the level of hazard represented by a particular container and the severity of the injury described in the warning effect individual's ability to recall the information presented in a warning? If so, are compatible or incompatible relationships more effective at increasing accurate recall of the level of hazard associated with the product?

METHOD

EXPERIMENT 1

Purpose

The purpose of this experiment was to select two containers perceived as high hazard and two containers perceived as low hazard from a range of possible containers to serve as stimuli in Experiment 3.

Method

Participants

Thirty-four Rice University undergraduate students participated, 22 females and 12 males. The mean age of participants' was 18.9 years, with a range of 18-21. The students received course credit for their participation. Participation was limited to students with normal color vision.

Materials

The computer program Netscape was used to display pictures of 36 containers. The containers represented a range of different packaging types. They varied along numerous dimensions including shape, color, lid type, and composite material. Labels did not appear on any of the containers. The photographs of the containers were taken from two catalogs: Berlin Packaging: Complete Container / Closure Sourcebook: 1997 Master Catalog, and Plastics (a listing of packaging produced by United States Plastic Corporation). The photographs were all formatted to appear at approximately the same size, 7.5 x 6 inches. The images were retouched to insure equal clarity using two pieces of software: Adobe Illustrator and Adobe PhotoShop.

A modified version of the questionnaire developed by Wogalter et al (1997) was used. It contained the following eight questions:

1. Based on the appearance of this container, how hazardous would you rate its contents?
2. Based on the appearance of this container, how hazardous would you rate its contents to be to eat or drink?
3. Based on the appearance of this container, how hazardous would it be to inhale its contents?
4. Based on the appearance of this container, how hazardous would it be for its contents to contact the skin?
5. Based on the appearance of this container, how hazardous would it be around children?
6. Based on the appearance of this container, how hazardous would it be to use in a closed space?
7. Based on the appearance of this container, how hazardous would it be to have its contents around an open flame?
8. How familiar are you with this type of container?

Each questionnaire item was associated with a 9 point Likert-type scale. A rating of zero represented the minimum and eight the maximum quantity on a given dimension. Participants responded to all eight questions for each of the 36 containers. These questions appeared under the container picture on the computer screen.

Procedure

Participants were seated at individual computer stations. Each participant was asked to enter a seven-digit identification number of their choosing, as well as their age and gender, in the appropriate field on the computer screen. After they completed this task the following instruction appeared on their computer screens:

“Thank you for your participation in this experiment. Your task is to evaluate the hazardousness of various containers that will be presented to you on your screen. There are eight questions you need to answer for each container. These questions will appear one at a time underneath the picture of the container on your screen. To record your response simply click in the box that appears above the number of your response choice. Once you have answered all eight questions for a particular container a new container will appear on your screen and you will be asked to answer the same eight questions for this container. You may take as much time as you like. Please ask the experimenter if you have any questions. When you are ready to begin please click on the start box below.”

Participants viewed a total of 36 container pictures. The pictures of the containers were presented in a random order to each participant. This ordering was determined by a randomization procedure that was built into the program. Participants used the mouse to click in the box that corresponded to their response for each question. The picture of the container remained present the whole time participants were responding to the questions associated with it. Participants had control over how long they spent viewing each container. After responding to all eight questions for a particular container participants

were shown a new container and entered responses for the same eight questions for the new container. This procedure was followed for all 36 containers.

Results

Wogalter et al (1997) found that questions one through seven of their questionnaire produced highly correlated responses and appeared to measure the same underlying dimension. Therefore their procedure of taking the average of these 7 questions to produce an overall perceived hazard for a particular container was employed. This procedure of using multiple questions rather than a single index to produce a perceived hazard rating was followed in order to assure the accuracy of the ratings. That is, using a redundant measure ensures that a container was viewed as hazardous across a range of dimensions, rather than simply seen as having contents that, for example, are viewed as hazardous to use around an open flame but safe for use in an enclosed space.

Containers whose hazard score was below 2 or above 7 were selected for further analysis. This resulted in 5 high hazard containers and 6 low hazard containers. The difference between the perceived hazard scores for each combination of low or high hazard container was compared in order to find the low hazard pair and the high hazard pair with the lowest within-group difference score. Figure 1 displays the 4 containers that make up the high perceived hazard and low perceived hazard pairs. The mean and standard deviation of the perceived hazard and familiarity scores for the 4 containers are displayed in Table 1.

High Hazard 1

High Hazard 2

Low Hazard 1

Low Hazard 2

Figure 1: Container shapes selected to be used as stimuli for Experiment 3

An alpha level of .05 was used for all statistical tests. The perceived hazard ratings of the two high hazard containers were compared using a paired sample t-test. This analysis failed to reveal a significant difference between the perceived hazard scores of the two high hazard containers, $t(33) = 1.72$; $p = .095$. The perceived hazard ratings of the two low hazard containers were also compared using a paired sample t-test. The analysis failed to reveal a significant difference between the perceived hazard scores of the two low hazard containers, $t(33) = 1.51$; $p = 0.142$. The familiarity ratings of all four containers were compared using a one-way ANOVA, repeated measures design. The analysis failed to reveal a significant difference between familiarity ratings, $F(3,31) = 1.31$; $p = 0.274$.

Table 1

Mean and Standard Deviation of Container Perceived Hazard and Familiarity Scores

Container	Perceived Hazardousness		Familiarity	
	<u>M</u>	<u>SD</u>	<u>M</u>	<u>SD</u>
High Hazard 1	7.9	0.78	7.29	1.43
High Hazard 2	7.54	1.04	7.15	1.44
Low Hazard 1	1.95	0.56	7.35	1.37
Low Hazard 2	1.75	0.08	7.79	1.59

Note: N = 34

Discussion

The purpose of Experiment 1 was to select two high hazard and two low hazard containers to be used as stimuli for Experiment 3. The familiarity level of the four containers was also compared to assure that all four containers are equivalent with regards to this variable in order to control for any confounding influence it could exert in the later studies.

The perceived hazard ratings of the two high hazard containers were compared. They are not significantly different along this dimension. The same holds two for the two low hazard containers. The actual containers selected to represent the two and high hazard levels are consistent with Wogalter et al. (1997) conclusion that individuals' perceptions of the level of hazard associated with the contents of specific containers are based on previous experience with known products in similar containers.

The two high hazard containers were both advertised in the Berlin Packaging: Complete Container / Closure Sourcebook: 1997 Master Catalog as chemical storage containers. Obviously, chemicals are relatively hazardous consumer products. High hazard Container 1 is a drum that is sold to hold hazardous chemicals. High Hazard Container 2 is a metal can that is used to hold flammable materials such as gasoline. Both these containers are dark in color, have lids that are not easily removed, and are composed of metal. However, as discussed previously, in assessing the hazardousness of containers people do not separate the individual contribution of these factors, instead, the container and its various features combine and interact to influence these ratings. Also, from a manufacturing standpoint, these factors are interrelated, with one constraining the expression of the other. For example, metal containers cannot be manufactured with flip-top type lids due to the characteristics of metal. These factors combine with the container shape to produce a container that is used to store hazardous materials.

The two low hazard containers were both advertised in the Berlin Packaging: Complete Container / Closure Sourcebook: 1997 Master Catalog as food storage containers. This is consistent with Wogalter et al.'s 1997 finding that the low hazard containers were those that looked like they would be used to hold liquid food products. Low Hazard Container 1 is sold to hold sauces, and Low Hazard container 2 is sold to hold beverages such as milk. Both containers have lids that allow for the easy access of the contents, are light in color, and are composed of plastic. These factors combine with the container shape to produce a container that is used to store food products.

EXPERIMENT 2

Purpose

The purpose of this experiment was to collect comprehension and severity ratings for a set of warnings so that four warnings describing a high severity injury and four warnings describing a low severity injury could be selected to be used in Experiment 3. Comprehension ratings were used to assure that all of the warning messages were easily understood. Therefore, only warnings with a comprehension level of 2 or below (see Design and Procedure for scale) were considered for Experiment 3. The second purpose of this experiment was to select pictorials to pair with the written warning text in experiment 3 in order to create high quality warnings.

Method

Participants

Twenty-five Rice University undergraduate students participated, 15 females and 10 males. The mean age of participants was 19.3 years, with a range of 16 years-22 years. The students received course credit for their participation. Participation was limited to students with normal color vision.

Design and Procedure

Participants in this experiment completed two tasks. The first task required participants to describe the meaning of fifteen pictorials. Thirteen of the pictorials were gathered from the Westinghouse Product Safety Labeling Handbook (1981) and the National Bureau of Standard's Symbols for Industrial Safety (1982), and two were designed by the experimenter. The pictorials depict the following concepts:

- 1) Wear gloves
- 2) Wear safety goggles
- 3) Skin damage/chemical burns can be caused if this product touched your skin
- 4) Wear a face mask
- 5) Do not ingest
- 6) Do not get this product in your eyes
- 7) Inhalation hazard/ dangerous fumes.

Each of the depicted concepts was redundant upon an instruction contained in one or more of the warnings presented in task two. That is, each of the pictorials depicted an idea that was also described in one or more of the warning pairs.

Pictorials were presented in a booklet, one per page. The order of presentation was randomized for each subject. The following instructions appeared on the first page of the booklet:

“On the following pages you will see several images which are commonly used to convey a safety message. On the lines following each image please describe in your own words the message you feel the image conveys. Please ask the experimenter if you have any questions.”

After participants completed the first task they received a new booklet containing task 2. In this task participants viewed a set of sixteen warning texts. Half of the warnings described severe potential injuries, and half described rather mild potential injuries. The warnings were written in pairs so that each severe injury warning was matched with a similar mild warning. That is, the type of injury described was constant

within a warning pair. Examples of the types of injuries described included eye injuries, respiratory injuries, skin injuries. The following is an example of a warning pair:

A severe potential injury :

Hazardous if inhaled. Prolonged breathing of fumes can result in permanent lung damage including decreased lung capacity and inability to breathe without a respirator. A facemask must be worn during long duration exposure. If difficulty breathing occurs seek emergency medical attention.

A mild potential injury:

May cause irritation if inhaled. Prolonged breathing of fumes may cause mild coughing, and temporary throat irritation or dry mouth. It is recommended that a facemask be worn for long duration exposure. If irritation occurs discontinue use and seek fresh air.

The warnings were designed to comply with the ANSI (1991) Z535.4, section 4.7.2, standard concerning message content. Each warning message identified the hazard, indicated how to avoid the hazard, and advised of the probable consequences of not avoiding the hazard. Each warning also included a first aid statement. The warnings described a range of potential hazards that involve a personal injury as a consequence. The word count of each the warnings was controlled to fall between 37 and 42 words.

The warnings were presented in a booklet, one warning per page. The warning text appeared at the top of the page. The following questions appeared below each warning:

1. How severe to you feel the potential injury described by this warning is?
2. How easy is the information contained in this warning to comprehend?

Each question was associated with a 9 point Likert-type scale. A rating of zero on Question 1 indicated an extremely mild injury, and eight indicated an extremely severe injury. For question two, a rating of zero indicated that the warning was extremely easy to comprehend, and eight indicated that the warning information was extremely difficult to comprehend. Participants responded both questions for a particular warning before moving on to the next.

Results

The difference between the severity of injury rating for each pair of warnings was calculated. The four pairs of warnings with the largest difference between the means of the high and low severity version of the warning were selected to be used in Experiment 3. The four warning pairs are listed in Appendix A. The mean and standard deviation of the severity score and comprehension scores for the 4 warning pairs are displayed in Table 2.

Table 2

<u>Injury Type</u>	<u>High Severity of Injury</u>				<u>Low of Severity Injury</u>			
	severity		comprehension		severity		comprehension	
	<u>M</u>	<u>SD</u>	<u>M</u>	<u>SD</u>	<u>M</u>	<u>SD</u>	<u>M</u>	<u>SD</u>
Eye	6.96	0.78	1.96	1.27	2.84	1.03	2.00	1.15
Skin	6.92	0.95	1.68	1.31	3.12	1.30	1.84	1.79
Lung	7.12	0.88	2.00	1.38	3.04	1.13	1.88	1.56
Ingestion	7.12	0.78	1.56	1.36	3.20	1.35	1.24	1.51

Note : N =25

All of the warnings reached the pre-set criterion of a comprehension rating of 2 or below. As this was a within subjects design, differences in severity of injury ratings as a function of type of injury were compared using two-way MANOVA. Analysis did not reveal a significant effect for type of injury, Wilks' Lambda = 0.85, $F(3, 22) = 1.32$; $p = 0.29$. A significant effect was found for severity of injury, Wilks' Lambda = 0.05, $F(1, 24) = 434.68$; $p < 0.0001$. The interaction between severity of injury and type of injury failed to reach significance, Wilks' Lambda = 0.94, $F(3, 22)$; $p = 0.70$.

The experimenter evaluated the accuracy of participants' descriptions of the pictorials' meanings. These descriptions were scored simply as correct or incorrect. Eight of the pictorials reached the 85% comprehension rate. Of the eight, four pictorials that depicted a message contained in one of the four pairs of warnings were selected. These pictorials will be paired with the corresponding warning text in the High Quality Warning condition in Experiment 3. The 4 pictorials, the message each conveys, and the percent comprehension are displayed in Figure 2.

Wear a facemask.

85%

Wear eye protection.

97%

Wear gloves.

100%

Do not swallow

91%

Figure 2: Pictorial correct identification percentage (N=25).

Discussion

The warning texts selected to be used as stimuli in Experiment 3 present a high severity of injury outcome and a low severity of injury outcome for four unique types of injuries. This study validated these warnings; the high severity of injury warnings were found to be significantly higher in terms of the level of severity presented than the low severity of injury warnings.

Injury type did not have an effect on severity ratings. In addition, no interaction was found between type of injury and the severity of injury. This was important in that the warning texts were designed to represent either a high or low severity construct in Experiment 3, and the severity of injury conveyed should not differ between the four warnings within a severity level.

EXPERIMENT 3

Purpose

This experiment was designed to address the following issues:

1. Are consumer product warning labels that adhere to the ANSI 235 product warning guidelines (including color, pictorials, and text) more effective than warnings that simply contain text in attracting individual's attention and subsequent retention of the informational content?
2. Does the perceived hazardousness of a container increase the likelihood that a user will look for or notice a warning and recall the information that was presented in it?
3. Does the severity of the potential injury presented in a warning influence how well the warning is recalled?

4. Does the compatibility of the level of hazard represented by a particular container and the severity of the injury described in the warning effect individual's ability to recall the information presented in a warning? If so, are compatible relationships more effective at increasing accurate recall of the level of hazard associated with the product?

Method

Participants

Sixty-four Rice University undergraduate students participated, 39 females and 25 males. The mean age for participants was 19.6 years, with a range of 18-23. The students received course credit in return for their participation. Participation was limited to students with normal color vision.

Design

This was a 2x2x2 mixed subjects design. There were two within subject variables; container hazardousness and warning quality. The container hazardousness variable had two levels, high and low. The four containers selected in Experiment 1 represented the two levels of container hazardousness. Refer to Figure 1 to view these containers.

The warning quality variable was manipulated through the use of labels that appeared on each of the containers. A warning appeared at the top of each rectangular label, followed by a recycling statement, EPA regulation information, and manufacturer identification. The warning quality variable had two levels, high quality and low quality. The high quality warnings were based on the ANSI Z535.4 (1991) warning standard for consumer products. They contained color, signal icons, pictorials, and organized text.

The pictorials used were based on the results of Experiment 2, and are presented in Figure 2. The low quality warnings contained only text. The additional information that appeared on the labels was similar, but not identical for all the containers in order to add realism without introducing confounding variables. The manufacturer was identical on all the labels. Labels were of approximately equivalent word count, and identical in size and shape. See Figures 3 and 4 for example high and low quality warning labels.

Figure 3: High Severity, High Quality Warning Label Example

Figure 4: High Severity, Low Quality Warning Label Example

The third independent variable, a between subject variable, was the severity of the potential injury described in the warning. This variable had two levels, high and low. An example of a high severity injury was skin contact resulting in nerve damage and loss of sensation. The complementary low severity injury was skin contact resulting in skin irritation and a brief tingling sensation. The four warning pairs used were selected based on the results of Experiment 2. The warnings that individual participants saw described either all high severity injuries or all low severity injuries. The sixteen warning labels used to manipulate the severity of injury and warning quality variables are presented in Appendix B.

Severity of the potential injury was manipulated as a between subject variable due to the nature of the questionnaire items, all of which involved some form of recall. These items included participants' recollection of; 1) viewing the various containers, 2) whether

or not warnings were present on the containers, 3) the severity of the injury described in the warnings, 4) the concepts described in the warnings. Because recall ability was involved in the variables being studied, the number of stimuli that a particular participant views had to be limited. In other words, the amount of information encountered had to be a manageable memory load. Severity of injury was therefore manipulated as a between rather than within subject variable. This design resulted in the 8 cells depicted in Figure 5.

High Severity Injury				Low Severity Injury			
Container Hazardousness	Warning Quality			Container Hazardousness	Warning Quality		
		High	Low			High	Low
	High	HH	LH		High	HH	LH
	Low	HL	LL		Low	HL	LL

Figure 5: The 8 cells representing all variable combinations.

Procedure

Upon arriving for the experiment participants were randomly assigned to either the high or the low severity of injury condition through a lottery. Half the computers in the laboratory had the high severity of injury program running on them (those on the left side of the room) and half had the low severity of injury program running on them (computers on the right side of the room). Participants drew a piece of paper from a container. The paper had either a L or a R on it. Those with R were told to sit on the right side of the room, those with L on the left.

Pictures of containers and instructions were presented to participants on the computer screens. Participants recorded their responses on paper and pencil questionnaires. The experiment was divided into three parts. In Part 1 participants viewed 6 containers with warning labels presented to them on a computer screen. The first and the last containers in the sequence were decoy containers, and were not part of the final data analysis. Their presence was simply to control for primacy and recency effects, and also to allow for their removal in the final memory task to add increased difficulty and realism. The decoy containers were the same for all participants.

The middle four containers represented the four combinations of container hazard level (high or low) and warning quality (high or low). The computer program presented the four conditions to each subject in a random order, with the same first and last picture (the decoys) for every participant. Each of the middle four containers appeared with a warning label that described one of the four types of injuries (eye, skin, lung, or ingestion) selected in Experiment 2.

The specific combinations of quality of warning, container hazardousness, and type of injury were randomly paired for each subject. The program displaying the warnings follows three steps in order to ensure random presentation. The first step is the random selection of one of the four different types of warnings to show first, for example, the eye hazard. Second, it randomly selects one of the four containers to display the warning on (High Hazard 1, High Hazard 2, Low Hazard 1, or Low Hazard 2). Third, within a particular container hazard level, it randomly selects either the high or low quality version of the warning to display. The program then repeats this procedure with

the remaining level of each variable and selects the second item to be displayed. The process is continued until all four possible combinations of container hazardousness and warning quality have been shown, each with different type of injury described on their warning.

Participants recorded their age and gender on the answer sheets before beginning Part 1. They then received the following instructions:

“We are concerned with consumer’s perceptions of product appearance. You are going to be viewing a series of 6 containers. Each container will appear in front of you on the computer screen for a fixed time interval. Your task is to evaluate how attractive you feel the packaging is. You will be shown only the back of the containers, and, in order to ensure that you are not influenced by product name, all reference to the product name has been removed. When considering attractiveness, please consider all aspects of the container, including the labeling. Please rate the attractiveness of the packaging on a scale of one to five. A rating of 1 indicates that you feel the packaging is very unattractive, a rating of 3 that it is moderately attractive, and a rating of 5 that it is extremely attractive. Please rate the containers as you go. Please record your ratings in Part 1 of your questionnaire. After you have been shown all the containers the computer will prompt you to the second part of this experiment. Please follow the instructions that appear at that time.”

This task ensured that participants looked at the containers and disguised the true nature of the experiment, discouraging active memorization of the warning contents due to demand characteristics.

After viewing all six containers participants turned to Part 2 of their questionnaires. At this time they received the following instructions:

“You will now see pictures of several containers, including some of those you viewed in Part 1 of the experiment. All the containers will be displayed without their labels. Your task is to answer six questions concerning your prior experience with each container. Please enter your responses on the questionnaire. After you have completed the set of 6 questions for a particular container please click the mouse to move to the next container.”

After receiving these instructions participants were shown pictures of each of the four containers (High Hazard 1, High Hazard 2, Low Hazard 1, and Low Hazard 2) without the labels, as well as two decoy containers that they have not previously seen. The container pictures were presented in a random order for each participant.

Participants were asked to answer the following 6 questions for each container:

1. Did you view this container (with a label on it) in Part 1 of the Experiment?
2. Did you read the label that appeared on the container in Part 1 of the Experiment?
3. Did you notice a warning in the label?
4. To the best of your ability please record as much of the information contained in the warning as you can recall.
5. How severe is the potential injury described in this warning?

6. If you were using the product contained in this container would you obey the warning you recall seeing?

Participants who responded negatively to questions 1-3 were obviously not required to answer Questions 5 and 6. Questions 1, 2, 3, 5, and 6 were associated with a 7-point Likert type scale. On Questions 1-3 a rating of 1 indicated that participants were certain that they had not performed the activity in question, a rating of 4 indicated that they were uncertain whether they had performed the activity in question, and a rating of 7 indicated that they were certain that they had performed the activity in question. On Question 5 a rating of 1 indicated the injury was mild, 4 indicated it was moderate, and 7 indicated that the injury was severe. On Question 6 a rating of 1 indicated that the participant definitely would not obey the warning, a rating of 4 indicated that they might obey the warning, and a rating of seven indicated that they definitely would obey the warning. Question 4 was associated with a free response format in which participants recorded as much of the warning information as they recalled.

After completing Part 2 participants received the following instructions:

“Please turn to Part 3 of your questionnaire. You will now be shown some of the containers with their labels as they appeared to you in Part 1 of this experiment. Your final task is to answer a couple of questions concerning each of these containers.”

Participants were then shown the middle four container pictures (with labels) that they had viewed in Part 1. These pictures were presented in random order. Participants were asked to respond to both of the following questions for each picture presented:

1. How consistent do you feel the information contained in this warning label is with type of container it is presented on? That is, would you expect to see a warning label containing this sort of information on a container that looked like this?
2. How common do you feel it is based on your experience to see a warning label in general on this sort of container?

These questions served as a manipulation check. Both questions were associated with a 7-point Likert type scale with 1 indicating a minimum and 7 indicating a maximum quantity on the dimension.

Results

An alpha level of .05 was used for all statistical tests. Responses to Questions 1-6 were analyzed using a three-way ANOVA with repeated measures on two factors. The results of these analyses are reported in order beginning with Question 1. Question 1 asked participants to rate the confidence that they had viewed the container in the first portion of the experiment. See Figure 6 for a graphical representation of means scores for each condition. The Container Hazard Level X Warning Quality X Injury Severity interaction was not significant, $F(1, 62) = 0.001$, $p = 1.0$. The three two-way interactions also failed to achieve significance. There was a significant main effect for container hazard level, $F(1, 62) = 13.923$, $p < 0.001$. Participants were more confident in their recollections of having previously viewed the high rather than the low hazard containers. All other main effects failed to achieve significance.

Figure 6: Mean confidence in having seen the container in Part 1

Question 2 asked participants whether or not they read the container's label.

Once again the three-way interaction between container hazard level, warning quality, and injury severity was not significant, $F(1,62) = 0.24, p = 0.624$. The Container Hazard X Severity of Injury interaction was significant, $F(1,62) = 8.19, p < 0.01$. This interaction is displayed graphically in Figure 7. When the container hazardousness was high participants' reports of reading the label did not vary as a function of the severity of injury, but when the container hazardousness was low participants were more likely to report reading the label when the potential injury was severe as opposed to mild.

The two-way Warning Quality X Injury Severity interaction was also significant, $F(1,62) = 4.41, p = 0.04$. This interaction is displayed graphically in Figure 8.

Participants were increasingly likely to report having read the label when the warning was high quality describing a severe injury as opposed to a mild one, but when the

quality of the warning was low the severity of the injury was not relevant. Participants were most certain that they had read the labels when the warning quality and the severity of the described injury were both high.

The final two-way interaction between container hazardousness and warning quality was also significant, $F(1,62) = 4.22, p = 0.04$. This interaction is displayed graphically in Figure 9. Reports of having read the warning did not vary as a function of warning quality when the level of container hazardousness was high, but when the level of container hazardousness was low reduced warning quality led to a decrease in confidence in having read the container's label. The main effect of container hazardousness was significant, $F(1,62) = 8.63, p = 0.005$, as was the effect of warning quality $F(1,62) = 5.58, p = 0.02$.

Figure 7: Mean confidence in having read the warning label for Container Hazard by Injury Severity collapsed across Warning Quality

Figure 8: Mean confidence in having read the warning label for Warning Quality by Injury Severity collapsed across Container Hazardousness.

Figure 9: Mean confidence in having read the container label for Warning Quality and Container Hazard collapsed across Injury Severity.

Question 3 asked participants to indicate their confidence in having noticed a warning in the product label. The means for each condition are displayed in Figure 10. The three way interaction, as well as all two-way interactions, failed to reach significance at the .05 level. A significant main effect was revealed for warning quality, $F(1, 62) = 16.44, p < 0.001$. Participants were more likely to notice a warning when it was high quality than when it was low quality. The main effects of container hazardousness and injury severity were not significant.

Question 4 asked participants to recall as much of the information contained in the warning as possible. The recalled warning content was evaluated as the number of correct items recalled. This number can range from zero to six. A score of six indicated that the participant recalled all of the warning content, including the hazard, how to avoid the hazard, what will happen if they do not avoid the hazard, and the first aid statement. The potential costs of not avoiding the hazard and the first aid statement involved multiple concepts. Two judges evaluated the recalled warning content to ensure the accuracy of these ratings. The judges agreed on the number of items correctly recalled for every response.

The three-way interaction between container hazardousness, warning quality, and injury severity failed to reach significance, $F(1, 62) = 0.36, p = 0.55$. The relationship between the condition means is depicted in Figure 11. Overall recall for warning information was very poor. Many of the participants did not recall any of the warning information, resulting in average recall below 1 item. The three possible two-way interactions all failed to reach significance at the .05 level. There was a significant effect

for Warning Quality, $F(1, 62) = 9.17, p = 0.004$. Participants recalled more of the content of high quality warnings than low quality warnings. Twenty-four of the thirty-three participants (72.8%) within the high quality warning condition who recalled warning information remembered the information represented by the pictorial. This accounted for 48% of the total information recalled. All other main effects failed to reach significance.

Figure 10: Mean confidence in having noticed a warning

Data from sixty-two and sixty of the sixty-four participants was included in the analysis of the results from questions five and six respectively. Two of participants were dropped from the Question 5 analysis and four from the Question 6 analysis because they did not respond to these questions for all of the containers they were shown. The

participants dropped were equally distributed across the severity of injury condition; therefore cell sizes remained equal.

Figure 11: Mean Number of Warning Items Recalled

Question 5 asked participants to recall the severity of the potential injury described in the product warning. The results are displayed in Figure 12. The Container Hazardousness X Warning Quality X Injury Severity interaction failed to reach significance, $F(1, 60) = 0.001$, $p = 0.98$. The Container Hazardousness X Warning Quality and the Warning Quality X Injury Severity two-way interactions also failed to achieve significance, $F(1, 60) = 0.54$, $p = 0.46$ and $F(1, 60) = 0.009$, $p = 0.93$, respectively.

The Container Hazardousness X Injury Severity interaction was significant, $F(1, 60) = 6.76$, $p = 0.01$. This interaction is displayed in Figure 13. Ratings of injury

severity in the high injury severity condition did not vary as a function of container hazardousness; however, in the low severity condition the injuries described in warnings that appeared on the low hazard containers were rated as less severe than those that appeared on this high hazard containers. The analysis also revealed a significant main effect for warning quality, $F(1,60) = 8.50, p = 0.005$. The injuries described in high quality warnings ($M = 4.7$) were recalled as being slightly more severe than when they were described in low quality warnings ($M = 4.2$).

Figure 12: Mean Severity of Injury Ratings

Question 6 asked participants to indicate their cautious intent, that is, how likely they would be to obey the warning they viewed on the container when using the product it contained. The results are displayed in Figure 14. The Container Hazardousness X Warning Quality X Injury Severity interaction failed to reach significance, $F(1, 58) = 0.14, p = 0.71$. The Container Hazardousness X Injury Severity and the Warning Quality

X Injury Severity two-way interactions also failed to achieve significance, $F(1,58) = 0.33, p = 0.57$ and $F(1,58) = 1.26, p = 0.27$, respectively.

Figure 13: Mean Severity of Injury Rating Collapsed across the Quality of Warning.

Figure 14: Mean likelihood of obeying the product warning

The two-way Container Hazardousness X Warning Quality interaction was significant, $F(1,58) = 4.50$, $p = 0.04$. This interaction is depicted in Figure 15.

Decreasing the quality of the warning is related to a greater decrease in reports of cautious intent when the container was low as opposed to high hazard. The analysis also revealed a significant main effect for severity of injury, $F(1,58) = 5.65$, $p = 0.02$, container hazardousness $F(1, 58) = 19.64$, $p < 0.001$, and warning quality $F(1, 58) = 12.11$, $p < 0.01$.

Figure 15: Mean likelihood of obeying the product warning collapsed across severity of injury

The purpose of Part 3 of the questionnaire was a manipulation check to determine if differences existed between the two levels of container hazardousness in terms of their compatibility with warnings in general. That is, do consumers expect to see warnings on these sorts of containers? Differences within a container hazard level would indicate a

confounding of the results from Question 1-6 of Part 2. Because of the nature of the question, data from Part 3 of the questionnaire was collapsed across warning quality levels for analysis. Therefore two two-way mixed design ANOVA's with repeated measures on one factor were used to analyze the data from each question; one for the low hazard containers at the two severity levels, and one for the high hazard containers at the two severity levels.

The first question in Part 3 asked participants to indicate how consistent the information listed in the warning was with the container it appeared on. The means for each condition are displayed in Figure 16. From the graph it is obvious that warnings were viewed as much more compatible with the high rather than the low hazard containers. The High Hazard Container X Severity of Injury and the Low Hazard Container X Severity of injury interactions both failed to reach significance, $F(9,62) = 0.22, p=0.64$, and $F(1,62) = 1.23, p= 0.27$ respectively. Within the low hazard container condition the main effect of low hazard container was not significant, $F(1, 62), = 1.23, p = 0.27$. The main effect of high hazard also failed to reach significance with in the high hazard condition, $F(1,62) = 0.22, p = 0.64$.

The second question in Part 3 asked participants to indicate how common, based on their prior experience, it was to see a warning in general on each of the containers. The means for each condition are displayed in Figure 17. From the graph it is obvious that once again warnings were viewed as much more compatible with the high rather than the low hazard containers.

Figure 16: Mean ratings of the compatibility of the informational of the warnings with the type of containers they were presented on. Higher ratings indicate greater compatibility. The abbreviations used are as follows:

HH1 = High Hazard Container #1

HH2 = High Hazard Container #2

LH1 = Low Hazard Container #1

LH2 = Low Hazard Container #2

The High Hazard Container X Severity of Injury and the Low Hazard Container X Severity of injury interactions both failed to reach significance, $F(9,62) = 0.02$, $p=0.88$, and $F(1,62) = 1.27$, $p= 0.26$ respectively. Within the low hazard container condition the main effect of low hazard container was not significant, $F(1, 62) = 1.83$, $p = 0.89$. The main effect of high hazard also failed to reach significance within the high hazard condition, $F(1,62) = 0.10$, $p = 0.76$.

Figure 17: Mean ratings of the compatibility of the presence of a warning with the type of container it was presented on. Higher ratings indicate greater compatibility. The abbreviations used are as follows:

HH1 = High Hazard Container #1
 HH2 = High Hazard Container #2
 LH1 = Low Hazard Container #1
 LH2 = Low Hazard Container #2

Discussion

This research examined the influence of several attributes of warnings and containers in drawing attention to warning information. This can be divided into four major issues. The first issue concerned the relative effectiveness of high quality warnings (those that adhere to ANSI 235 guidelines) versus low quality warnings (those that contained only text) in attracting attention to and subsequent retention of warning information. The answer provided is straightforward; high quality warnings are more effective. Individuals were more likely to report having noticed the high quality warnings. Further, recall of warning information was significantly greater when the information was presented in a high quality warning. Consistent with past research (Young, 1992), these results demonstrate that including the enhanced features of color,

signal icon, and pictorials in warnings increases the likelihood that warnings will be noticed and read.

The contribution of pictorials, however, is not limited to increased salience. Pictorials also convey information. The increased recall in the high quality warning condition may not simply be the result of increased attention to these warnings. It is possible that the redundancy of the pictorial and the text contributed to improve retention by promoting dual coding of information. This notion is supported by the fact that information recalled by over 70% of the participants who were able to reiterate at least one piece of information contained in the high quality warnings included the message conveyed by the pictorial.

The second question concerned whether the severity of the injury presented in a warning influenced recall of warning information. The answer to this question is “No”. It appears that once individuals decide to read a warning, severe injuries are not recalled any better than mild injuries. This is rather surprising, in that one would expect that the more devastating the consequence, the more memorable.

The lack of differences in recall due to severity of injury may be a result of the experimental manipulation. Participants viewed containers on a computer screen; therefore the possibility that participants would actually have to use the products they contained did not exist. Knowing this, dangers associated with product use become less important and additional attention is not devoted to processing the warning information.

The third question addressed was whether the perceived hazardousness of a container influenced the likelihood that a user would read a product label, attend to a

warning, and recall the information presented. The answer to the first portion of this question remains unclear. A main effect was found for container hazardousness. People reported reading the labels on high hazard containers more often than on low hazard containers. The interpretation of this result is complicated by the fact that an interaction exists between injury severity level and container hazardousness.

In terms of reading product labels, these findings indicated that when the severity of injury was high individuals read the labels equally for both levels of container hazardousness. However, when the injury described in the warning was relatively mild, reports of reading the label decreased when it appeared on a low hazard container. Obviously, in order for the severity of the injury presented in a warning label to be known consumers had to read the label. These results therefore indicate that rather than measuring whether or not people actually read the product labels, this measure is instead tapping into people's memories of having read the label. It appears that container hazardousness and injury severity interact to bias memory of having read product labels.

A clearer answer to this question can be found in the performance of individuals in recalling the content of warnings. As noted earlier, participants did not recall a greater amount of information for warnings presented on high rather than low hazard containers. This can be taken to indicate that participants were no more likely to read and attend to warnings when the hazardousness of the container was increased. Overall participants were very confident that they had noticed warnings on all of the containers; however, this did not vary as a function of container hazardousness.

The fourth question this research was designed to address is whether or not the compatibility of the level of hazard represented by a particular container and the severity of the injury described in the warning affect individual's ability to recall the information presented in a warning. The results of this study indicate that compatibility does not matter in terms of recalling the content of warnings. However, the hazardousness of containers does influence how severe the potential injury described on a warning label is recalled to be.

Overall, injuries described on high hazard containers are remembered as being more severe than low hazard containers. While this difference is negligible when injury severity is high, it becomes more pronounced when the severity of injury is low. Mild injuries presented in warnings on high hazard containers are recalled as much more severe than when they are discussed in warnings on low hazard containers. It appears that for high hazard containers the hazard level of the container biases perceptions of warning severity. Taken with the finding that individuals report the presence of warning labels, regardless of their content, to be much more compatible with high hazard versus low hazard containers, this indicates that judgements of severity are not objective.

A possible explanation of these results has to do with LaRue and Cohen's (1987) finding that consumers expect to find warnings on products they perceive as hazardous. Intuitively it would appear that people expect warnings to contain information concerning serious types of injuries. Because the containers at the high level of hazard appear to have contents that have the potential to do harm, people rely on this heuristic rather than objective information when recalling the seriousness of potential injuries. However,

when presented with containers that appear to house innocuous content, consumers are less likely to expect a warning. If individuals recall having seen a warning, as they did in this study, they may be forced to rely on their perceptions of these warnings rather than those of the container. Therefore the severity of the information contained in the warnings that appear on low hazard containers is recalled more accurately than that which appears on high hazard containers.

While it is important that warning information is recalled, the ultimate measure of warning effectiveness is whether or not a consumer obeys the warning. The results of this study indicate that overall people report they would be slightly more likely to obey the warnings that appear on high hazard containers. What is interesting is that quality of warning interacts to influence reports of cautious intent. People report being less likely to obey the low quality warnings across both levels of container regardless of the severity of injury described. However, this reduction in cautious intent is greater for low hazard containers.

As discussed previously, high quality warnings attracted greater attention to and retention of warning information. It is not surprising therefore that people are more likely to exhibit cautious intent for warnings that they remember. Nonetheless, what is interesting is that the level of hazard conveyed by the container differentially modifies this relationship. This may have to do once again with the finding that warnings in general are seen as more compatible with high hazard containers. Intuitively, this indicates that people feel that there are injuries associated with the types of products in these containers that are serious enough to warrant a warning. If warnings are not viewed

as compatible with low hazard containers individuals may feel that “nothing bad” could happen as a result of the use of the products housed in such containers. Therefore it is not necessary to exercise caution with these products.

Features associated with the design of this study indicate several avenues for continued research. The first concerns the nature of the experimental task. Participants viewed the containers on a computer monitor. The purpose of this procedure was to control both the size at which the container was displayed and the duration of time individuals were allowed to view it. As a result, participants knew they would not have to use the products and simply did not pay much attention to warning information. Therefore memory for this information was relatively poor across conditions.

While the design of the experiment allowed the effects of the various combinations of container shape, warning quality, and severity of injury to be warnings to be parsed out from the influence of product type, the generalizability of this study to actual product use situations is limited. These variables could not realistically be manipulated by the inclusion of a product type variable, due to the fact that certain products produce certain types and degrees of injuries, and are housed in certain types of containers. However, by not including a product type variable its interaction with the other variables, as well as its influence on attention and retention of warning information, remains unknown. The notion of product type, however, does present an interesting compatibility issue in and of itself. Obviously, certain types of products are assumed to be housed in certain types of types of containers; therefore, the relationship between the

product housed and the container itself could be viewed as either compatible or incompatible. Further research is needed to determine the effects of such pairings.

A third factor that has implications when interpreting these results concerns the product labels themselves. These labels consisted almost entirely of a warning, as this was the variable of interest. However, in actual usage situations there is a great deal of additional information typically presented on the packaging. It is in these situations, however, that the results of this study become increasingly important. High quality warnings are more effective at attracting attention. Attracting attention to a warning becomes of heightened importance when it is embedded in a great deal of additional textual information. Further, the use of a pictorial to display critical information becomes increasingly important. Yet the majority of the warnings that appear on consumer chemical products do not contain pictorials. For example, a warning appears on the Lysol Toilet Bowl Cleaner label that states “Corrosive. Causes eye damage and skin irritation. Harmful if swallowed. May produce chemical burns. Wear protective eyewear and rubber gloves when handling...Never use with chlorine bleach or any other chemical product”. This product is quite capable of causing serious injuries; however, the warning label itself is simply a block of text. It is probable that the inclusion of a pictorial would increase attention to the warning, and based on the results of this study would also heighten warning compliance. This is something that more product manufacturers need to be aware of and incorporate into their label designs.

These results indicate that the hazardousness of containers does influence whether people read warning labels and subsequent reports of cautious intent. However,

its influence is modified by both severity of injury and warning quality. In addition, warnings are seen as being more compatible with high hazard containers. The most noteworthy finding of this research, however, is the importance of warning quality. Not only do enhanced features make warnings more noticeable, they also led to improved recollection of warning information. Therefore, when designing products labels careful attention should be given to insuring that warnings are of the highest quality.

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APPENDIX A
THE 4 WARNING PAIRS SELECTED IN EXPERIMENT 2

WARNING PAIR 1**Eye Injury****HIGH SEVERITY OF INJURY**

Eye contact is hazardous. If this product enters the eyes this could result in permanent loss of vision. Wear safety goggles when using this product. If eye contact occurs, flush eyes immediately with water, remove contacts, and seek emergency medical attention.

LOW SEVERITY OF INJURY

Eye contact may cause irritation. Contact with eyes may result in temporary redness and watering of eyes. Safety goggles are recommended when using this product. If eye contact does occur, flush eyes with water and remove contacts.

WARNING PAIR 2**Skin Contact Injury****HIGH SEVERITY OF INJURY**

Contact of this product with the skin is hazardous. Skin contact may cause severe nerve damage and permanent loss of sensation. Wear gloves when using this product. If skin contact occurs flush skin with water and seek medical attention.

LOW SEVERITY OF INJURY

Skin contact may cause irritation. If this product contacts skin it may cause a brief tingling sensation and temporary loss of sensitivity. Wear gloves when using this product. If skin contact occurs flush skin with water. If symptoms persist seek medical attention.

WARNING PAIR 3**Lung Injury****HIGH SEVERITY OF INJURY**

Hazardous if inhaled. Prolonged breathing of fumes can result in permanent lung damage including decreased lung capacity and inability to breathe without a respirator. A facemask must be worn during long duration exposure. If difficulty breathing occurs seek immediate emergency attention.

LOW SEVERITY OF INJURY

May cause irritation if inhaled. Prolonged breathing of fumes may cause mild coughing, and temporary throat irritation or dry mouth. It is recommended that a facemask be worn for long duration exposure. If irritation occurs discontinue use and seek fresh air.

WARNING PAIR 4

Ingestion Injury

HIGH SEVERITY OF INJURY

This product is hazardous if swallowed. Ingestion of this product can cause paralysis and potentially lead to death. Do not allow children to use this product. If ingestion occurs rinse mouth with water and seek immediate emergency medical attention.

LOW SEVERITY OF INJURY

Avoid swallowing this product. Ingestion of this product may cause temporary mild tingling or numbness in the extremities. It is recommended that children not use this product. If ingestion occurs flush mouth with water and if symptom persist contact your physician