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Communicating Severity of Hazard with the Signal Word on a Safety Sign

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An experiment examined five signal words on safety signs for effectiveness at communicating information about severity of a hazard. Perceived severity was rated by 59 college students for the signal words Deadly, Danger, Warning, Caution, and Notice. Results indicated that Deadly communicated the highest ratings for severity. Danger was second. Warning and Caution were tied for third. The lowest ratings were for Notice.

INTRODUCTION

Signs are used extensively in workplaces to identify hazards and provide instructions for appropriate behavior. A fundamental element of safety signs is the signal-word panel located at the top of the sign. The colors and words in this panel are intended to convey information about the hazard identified.

One type of hazard information concerns the severity of harm associated with the hazard. The standard of the American National Standards Institute (ANSI) uses three severity categories: (1) death or serious injury, (2) minor or moderate injury, and (3) property damage (ANSI Z535 Committee, 1998). The standard specifies that if the severity is death or serious injury, the signal-word panel should have the signal word Danger on a red background or the word Warning on an orange background. If the severity is moderate injury, minor injury, or property damage, the signal word Caution on a yellow background is used.

A theory for how perception of hazard severity influences safety-related behavioral decisions was described by Jensen and McCammack (2003). It is depicted as a flow-chart model in Figure 1. Basically, we hope a sign will influence a person's perception of how severe the harm caused by the particular hazard will be. This is called hazard severity in the warnings literature. That perception of severity plays an important role in shaping the person's perception of overall hazardousness. A person's perception of likelihood of harm also influences perception of hazardousness, but for non-catastrophic hazards the perception of severity has a stronger influence on perceived hazardousness (DeJoy, 1999; Wogalter, Young, Brelsford, and Barlow, 1999).

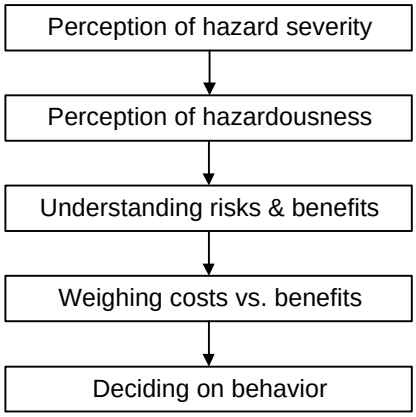

Figure 1. Connection between perception of hazard severity and behavioral decision

A person's perception of hazardousness is an integral part of their understanding of the risks posed by the hazard and the benefits of taking protective measures. Their understanding of risks and benefits is the principal informational input into the mental process involved in making a decision on behavior. A plausible theory is that people weigh costs and benefits in their decisions (Edworthy, 1998). The weighing is a subjective process partially determined by an individual's understanding of cost to comply and benefits from compliance. In other words, a person's safety-related behavioral decisions are based on his or her weighing of the risks and benefits, and the weighing process is dependent on the person's understanding of risks and benefits.

From this model it follows that sign designers should have a sign design goal to convey **accurate information**

about severity of harm and benefits of compliance in order to support informed behavioral decisions. This study investigated the effectiveness of signal words for conveying accurate information about severity.

METHODS

Subjects and Materials

Subjects consisted of 59 undergraduates from Montana Tech of the University of Montana. There were 31 males (52.5%) and 28 females (47.5%). To recruit students, a campus wide email was sent to all instructors. This email contained information about the experiment and asked the instructors to consider, if they planned to cancel a class within the next two weeks, to make their students available for participation in this study. Five instructors responded to the email, offering seven classes for participation. The students were told by their instructors that they were to come to class as usual, but a graduate student would be conducting an experiment. Students were also informed that they would receive ten dollars for their participation.

Twelve workplace safety signs were constructed. Five signs had a gray signal-word panel with a white signal word. The signal words were Deadly, Danger, Warning, Caution, and Notice. All letters were capitalized to conform to the ANSI standard. The signs differed only in the signal word located in the signal word panel. The signs were developed on a computer using Maxisoft software and then printed on 8.5 by 11 inch photograph quality paper. The message panels of all signs contained black lettering on a white background to comply with the ANSI standard. Borrowing a method from Wogalter, Kalsher, Frederick, Magurno, and Brewster (1998), X's were used in the message panel to make the sign look more like the signs encounter in workplace settings, without any kind of text message that might detract from the focus of the study.

Procedures and Analyses

Subjects were briefed on the experiment, and they signed an informed consent form before continuing. They were then provided with an answer booklet and the experiment commenced. Students first read a paragraph restating the instructions and answered three questions about age, gender, and whether they had been trained in how to interpret workplace safety signs. Signs were then shown in a predetermined random order at 45-second intervals. Students viewed a sign and then rated it on three scales presented on a page. This procedure was repeated for all signs. Then each sign was displayed again and subjects rated it on three other rating scales on a different page. Thus, each sign was rated on six scales. Ratings from a severity scale are reported here. The severity scale was an ordered rating scale derived from the ANSI standard with five response categories: death, serious injury, moderate injury, minor injury, and property damage.

Responses were assigned numerical values for data analysis. A zero was used for the least severe category, with other category values increasing by one as severity increased. The null hypothesis of no effect was tested using the Friedman Rank Sum two-way analysis. The post-hoc Student-Neuman-Keuls Tests was used to determine significance of rating differences among signal words. A significance level of 0.05 was employed.

RESULTS

Results indicated that the signal word had a highly significant effect on ratings using a Friedman Test. Post-hoc analysis indicated Deadly rated highest, followed by Danger. Below these words were Warning and Caution. Warning and Caution were not significantly different from each other. The lowest ratings were for the signal word Notice. Figure 2 is a bar graph showing the estimated median rating for each signal word. The estimated median is a statistic computed as the grand median plus or minus the effect size.

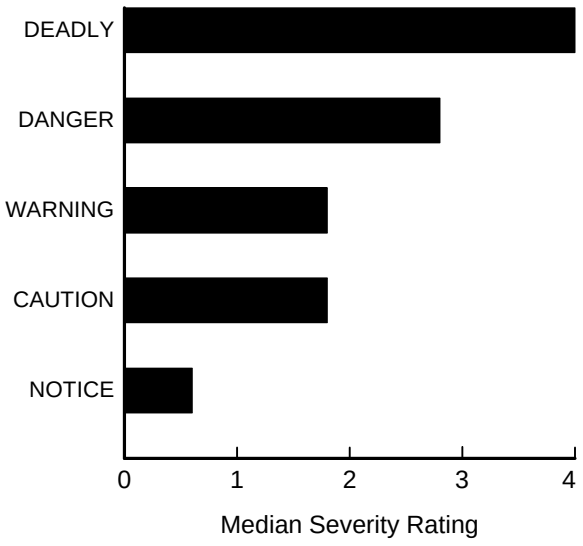

Figure 2. Estimated median severity ratings for five signal words tested

DISCUSSION

The finding that Deadly received the highest severity rating was not surprising. Previous investigations reported similar results (Leonard Hill, and Karnes, 1989; Wogalter et al., 1998).

According to the ANSI standards, Danger and Warning should convey the same severity message, i.e., death or serious injury. This experiment found otherwise. Subjects rated Danger significantly higher than Warning on the severity scale. Perhaps the ANSI Committee should reexamine the specifications for matching hazard severity levels and signal words.

The finding that severity ratings for Warning and Caution were not significantly different was also expected. Prior studies found perceptions of these signal words were similar for perception of overall hazardousness (Wogalter and Silver, 1995; Wogalter et al., 1998). This finding supports prior expressions of concern about the justification for keeping both words in the ANSI standard.

The finding that Notice received the lowest ratings for severity is completely consistent with prior studies such as Wogalter et al. (1998). It is also consistent with the ANSI Standard definition that Notice is for a sign containing information about company policy with safety implications. It is not intended for marking a hazard.

It would be useful to compare findings from these college students with a sample of working adults. A prior study comparing sign ratings by college students with those of people from industry revealed consistent ratings (Wogalter et al., 1998). However, there are still concerns, particularly in the legal community, about how representative college students are of the employed workforce. Therefore, a comparative study is recommended.

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