Printed Warning Statements and Signal Words On Intended Carefulness

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Previous research on textual warnings has mainly focused on individual signal words, but much less research has concerned signal words in context within warnings. The current study investigated printed (visual) warnings statements that contained signal words paired with hazard and instruction statements. These statements have been previously used in research on voice (auditory) warnings by Barzegar and Wogalter (2000). The results showed that participants rated warning statements containing hazard and instruction information paired with the signal word "DEADLY" significantly higher on intended carefulness than the same statements paired with the signal word "DANGER." Statements paired with a signal word were rated higher than statements without a signal word. Overall, the pattern of the ratings for the printed statements in this study concurs with that of Barzegar's and Wogalter (2000) voice warning data. Implications and suggestions to the design of effective warning statements are discussed.

INTRODUCTION

To most people warnings are multi-word hazard statements such as DANGER, HIGH VOLTAGE, KEEP OUT. However, most of the research that has systematically compared differences in the word of warnings has examined individual signal words, such as DANGER, WARNING, and CAUTION. When presented individually, some signal words have been shown to connote different levels of hazards (e.g., Wogalter & Silver, 1995). For example, DANGER is usually rated higher than WARNING or CAUTION, but there is little difference between perceptions of WARNING and CAUTION. There have been a few studies that have examined the influence of signal words in context such as on a product label (Adams & Edworthy, 1995; Wogalter, Jarrard, & Simpson, 1992). One study examined the relative effectiveness of the presence versus absence of signal words in a warning message context (together with hazard, instructions and consequence statements) and found that warning messages with a signal word were perceived more effective than those without a signal word (Wogalter, Godfrey, Fontenelle, Desaulniers, Rothstein, & Laughery, 1987).

Several studies (e.g., Barzegar & Wogalter, 1998a, 1998b; Edworthy, Clift-Matthews, & Crowther, 1998) have examined individually-presented voiced signal words. Generally, voiced signal words show a similar pattern of results to that of printed signal words. More recently, Barzegar and Wogalter (2000) compared auditorily-presented signal words in context of multi-word spoken warning statements. They found differences in intended carefulness between presentation expressiveness (e.g., emotional tone rated higher than monotone) and between statements that only differed in signal word.

Barzegar and Wogalter's (2000) statements have not been investigated in the print/visual modality. The present study uses the same statements used in Barzegar and Wogalter (2000) to determine whether (a) the pattern of ratings for a print version of the statements are similar to that of Barzegar and Wogalter's (2000) speech (voice) presentation findings, and (b) whether signal word manipulations, in context on otherwise identical warning messages, influence people's evaluations. Ratings were on a scale of intended carefulness. Other research has determined that this scale closely relates to hazard perceptions (e.g., Wogalter & Silver, 1995), which also relates to behavioral compliance (DeJoy, 1991).

METHOD

Participants

A questionnaire was distributed to a total of 200 individuals (95 males and 105 females) at various locales in the Raleigh-Durham area of North Carolina. The sample was collected as part of an ergonomics class

project at North Carolina State University. Ages of the participants ranged from 18 to 81 years (M= 32, SD = 15). Full-time students made up 46% of the sample and their average age was 22 (SD = 3). Non-students made up 54% of the sample and their average age was 41 (SD = 15). All participants reported having completed at least the 8th grade with the average education level attained being 3.1 years of college. For all but 10% of participants, English was the first language learned.

Materials and Procedure

A multi-page questionnaire was distributed containing items asking participants for their opinions about technology. One section requested demographic information such as age, gender, etc. Another section contained 12 warning statements along with instructions on how to evaluate them. The statements are shown in Table 1. Participants were asked to evaluate each of the listed warning statements according to how careful they would be after reading the warning signs. They made their judgments using a 9-point rating scale with the following numerical and textual anchors: (0) not at all careful, (2) slightly careful, (4) careful, (6) very careful, and (8) extremely careful.

There were two versions of the questionnaire, each with a different random order of statements. Each version was given to approximately half of the participants.

A short vignette was presented to participants before they started their ratings:

> "Imagine that you are doing some temp work for some extra money. Today you will be delivering some materials to a local construction site. There are several different individuals at the site waiting for the supplies you are delivering. You are responsible for delivering the supplies and receiving signatures upon their delivery. Please visualize yourself walking through the construction site. You see a set of warning signs containing some statements. For each of the following statements please rate *how careful would you be if you were to see a sign containing each of the statements*."

Participants were told to use the anchors of the rating scale to help guide their rating. They were told that they may give any whole number between 0 and 8 in making their ratings.

RESULTS

The mean carefulness ratings (and standard deviations) for each of the 12 statements for Barzegar's (2001) monotone voice style and the current study are shown in Table 1. A repeated-measures analysis of variance (ANOVA) conducted on the statement ratings was significant, $F(11, 2189) = 30.07$ $p<.001$.

Table 1. ***Mean carefulness ratings and standard deviations for the 12 warning statements.***

		Voiced from (Barzegar, 2000)		*Print Current Study*	
Statement Number	*Statements*	*Mean*	*SD*	*Mean*	*SD*
1.	DEADLY, Flammable Material, Keep Fire Away	4.96	2.3	6.32	2.0
2.	DEADLY, Combustible Material, Keep Fire Away	4.99	2.2	6.31	1.9
3.	WARNING, Electrical Hazard, Keep Out	4.03	2.1	5.90	1.9
4.	WARNING, Skin Irritant, Wear Gloves and Goggles	3.76	2.0	5.82	1.8
5.	DANGER, Fire, Use Stairs and Exit Immediately	5.99	2.1	5.81	2.3
6.	CAUTION, Electrical Hazard, Keep Out	4.13	2.1	5.76	1.9
7.	CAUTION, Skin Irritant, Wear Gloves and Goggles	3.77	2.0	5.56	1.8
8.	FIRE, Use Stairs and Exit Immediately	5.87	2.2	5.57	2.5
9.	DANGER, Flammable Material, Keep Fire Away	4.23	2.1	5.48	1.9
10.	DANGER, Combustible Material, Keep Fire Away	4.34	2.2	5.38	1.9
11.	STOP, Construction Area, Restricted Entry	2.61	1.7	4.91	2.2
12.	Construction Area, Restricted Entry	2.59	1.8	3.97	2.2

Comparisons among the means was made using Bonferroni/Dunn post-hoc test with a least significant difference of .62 at p=.01. Using this value to compare the means from the current study in Table 1, it can be seen that many of the statements are significantly different from one another. Comparisons between statements with respect to the signal word manipulations were performed. In these comparisons, the hazard and instruction statements were the same but the signal words differed or a signal word was absent. Statement 1 (DEADLY, Flammable Material, Keep Fire Away) (M=6.32) was significantly higher than Statement 9 (DANGER, Flammable Material, Keep Fire Away) (M=5.48). Statement 2 (DEADLY, Combustible Material, Keep Fire Away) (M=6.31) was rated significantly higher than Statement 10 (DANGER, Combustible Material, Keep Fire Away) (M=5.38). Statement 11 (STOP, Construction Area, Restricted Entry) (M=4.91) was rated significantly higher than Statement 12 (Construction Area, Restricted Entry) (M=3.97).

Three other relevant comparisons did not significantly differ. Statement 3 (WARNING, Electrical Hazard, Keep Out) (M=5.90) did not differ from Statement 6 (CAUTION, Electrical Hazard, Keep Out) (M=5.76) did not differ significantly. Statement 4 (WARNING, Skin Irritant, Wear Gloves and Goggles) (M=5.82) and statement 7 (CAUTION, Skin Irritant, Wear Gloves and Goggles) (M=5.56) also did not differ. Statement 5 (DANGER, Fire, Use Stairs and Exit Immediately) (M=5.81) and Statement 8 (FIRE, Use Stairs and Exit Immediately) (M=5.57) did not differ.

The correlation of the mean carefulness ratings from the current study using printed statements with those of Barzegar and Wogalter (2000) using voiced statements was examined. The Pearson product moment correlation of the means shown in Table 1 is .67 p<.001. When the present study's means are correlated to mean ratings of the individual voice styles (whisper, emotional and monotone) in Barzegar and Wogalter (2000), the correlations ranged from .69 to .71.

DISCUSSION

The present study investigated the level of intended carefulness of a set of printed warnings statements. These statements had been used by Barzegar and Wogalter (2000) in a study examining intended carefulness for voiced warnings. The results from the current study largely corroborate those of Barzegar and Wogalter (2000). Overall, the present study yielded a similar pattern of means. This finding indicates that participants were evaluating the meaning of the statements, not just the way the statements looked or sounded. Therefore, much of the effects between statements appear to be less modality-specific or sensory-based relative to the semantic interpretation of the terms.

Semantic processing is seen in the comparisons between statements that differ with respect to signal word. In two separate pairs of statements, the presence of DEADLY was given higher carefulness ratings than DANGER. The difference in connoted hazard between these two words is supported in other studies (e.g., Wogalter & Silver, 1990, 1995; Wogalter, Kalsher, Frederick, Magurno, & Brewster, 1998). Another relevant signal word comparison was between STOP and no signal word. The finding that a signal word is better than no signal word is well supported in the research literature (e.g., Wogalter et al., 1987; Wogalter, Kalsher, & Rashid, 1999).

Three relevant comparisons were not significant. Two compared the presence of WARNING versus CAUTION. The research literature has frequently failed to find an effect between these two terms (e.g., Leonard, Otani, Wogalter, 1999). Nevertheless, the American National Standards Institute's (ANSI) Z535 (2002) warning design standard distinguishes between WARNING and CAUTION in its guidelines as distinct and separable terms. Interestingly, the term DEADLY as a signal word is not mentioned anywhere in ANSI Z535 (2002).

Finally, the last relevant non-significant comparison was between the presence and absence of the term DANGER. While this is somewhat surprising given past research that has shown effects of DANGER, an explanation can be derived from the context within which this manipulation was placed. The accompanying text message was "Fire, Use Stairs and Exit Immediately." Thus, the term Fire may be serving as a strong signal word and the addition of DANGER does add much beyond that in terms of perceived hazard.

The present study shows that semantic interpretation of warnings is an important factor in people's judgments. Visual and auditory presentations can give rise to similar connotations. Signal words play a role in enhancing perceived hazard and intended carefulness, but their influence may depend on the choice of signal word and the context of the accompanying warning message.

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