

Intended Carefulness Ratings for Voiced Warning Statements

Rana S. Barzegar and Michael S. Wogalter

*Department of Psychology
North Carolina State University
Raleigh, NC 27695-7801*

ABSTRACT

The parameters that affect the efficacy of voiced warnings have only recently begun to be investigated. The current study examines the effects on intended carefulness ratings for voiced warning statements considering the following factors: sex of speaker, sex of participant, voice style (monotone, emotional, whisper), and sound level (low, high). Warning statements voiced in the emotional voice style and in a higher sound level produced the higher intended carefulness ratings. Implications for the design of voiced warnings are discussed.

INTRODUCTION

A basic goal of warnings research is to understand and implement methods for effectively conveying information on the presence of potential hazards and communicating instructions on how to avoid those hazards. The effectiveness of a warning can be indicated by the ability to capture attention and subsequently alter behavior in response to that warning. Many factors can contribute to the ultimate effectiveness of a warning. These factors include, but are not limited to, the warning presentation method (e.g., Wogalter & Young, 1991), presentation style (e.g., Barzegar & Wogalter, 1998a, 1998b), and warning content (e.g., Wogalter, Godfrey, Fontenelle, Desaulniers, Rothstein, & Laughery, 1987).

There are various methods for presenting warnings, including visual and auditory presentation. Print warnings have long been utilized as a method for displaying hazard information in signs and labels. A limitation of print warnings, however, is that the attention of the receiver of information must be directed toward the warning. Auditory warnings provide the benefit of being omnidirectional. By radiating in all directions, auditory warnings can, generally, capture an individual's attention and do not require the head to be directly oriented in the direction of the warning (e.g., a sign or label). Furthermore, research has shown greater levels of compliance for warnings presented by voice than the same message presented in print (Conzola & Wogalter, 1998; Wogalter, Racicot, Kalsher, & Simpson, 1994; Wogalter & Young, 1991).

Most research on auditory warnings consists of non-verbal sounds (e.g., beeps or buzzers). Research on non-verbal auditory signals has indicated that different sound parameters, such as pitch, loudness or rate, can affect an individual's level of perceived urgency (e.g., Edworthy & Adams, 1996). One potential limitation of non-verbal auditory warnings is when the receiver does not know the

meaning of the sound (beyond a perception of urgency). Voiced warnings can reduce the problem of communicating meaning through the auditory modality by articulating the content of the warning.

Recently, research (Barzegar & Wogalter, 1998a, 1998b; Edworthy, Clift-Matthews, & Crowther, 1998) has been conducted to examine the effects of sound parameters for voiced signal words. Barzegar and Wogalter (1998a, 1998b) examined the effects of various sound parameters on intended carefulness ratings for voiced signal words. They found that signal words spoken by females produced higher ratings than those spoken by males did. In addition, signal words presented in an emotional voice style produced higher ratings for intended carefulness than both the monotone and whisper voice styles. Edworthy et al. (1998) also found that voice style (appropriate vs. inappropriate) affected perceived urgency.

Barzegar and Wogalter (1998a, 1998b) also examined the effects on intended carefulness for various signal words, previously examined only in print warnings (Wogalter & Silver, 1995). The signal words examined include those recognized by the American National Standards Institute (ANSI, 1991, 1998). ANSI recommends the use of DANGER to represent immediate hazards which will result in severe personal injury or death. WARNING should represent hazards or unsafe practices that could result in severe personal injury or death. CAUTION is to represent hazards or unsafe practices that could result in minor personal injury and/or property damage. Despite the recommendation to use WARNING and CAUTION to represent different levels of hazard, individuals often do not perceive this difference (e.g., Barzegar & Wogalter 1998a, 1998b; Wogalter & Silver, 1990, 1995). ANSI (1991, 1998) also recognizes NOTICE as a method for indicating important, but non-hazard related information. In examining alternate signal words, research has consistently shown that DEADLY is perceived to

represent a higher level of hazard than DANGER (Barzegar & Wogalter 1998a, 1998b; Wogalter & Silver 1990, 1995; Wogalter, Frederick, Herrera, & Magurno, 1997).

Warnings usually consist of additional components. In addition to signal words, warnings often include the description of the hazard, the consequences of the hazard, and information on how to avoid the hazard. Wogalter and colleagues (1987) systematically manipulated these four warning components. Results indicated that omitting the hazard and instruction statements resulted in greater reduction of perceived effectiveness than the deletion of other components (Wogalter, Godfrey, Fontenelle, Desaulniers, Rothstein, & Laughery, 1987). However, the attention-capturing role of the signal word was diminished as participants' attention was already directed to the warnings. Wogalter et al. (1987) concluded that in situations in which the consequences are implied by the other warning components, they can be omitted from the warning. Generally, print warnings can accommodate all four components without concern for working memory. In the example of a print warning, the information content is readily available for review. However, in the case of voiced warnings there are concerns regarding the amount of warning information due to limitations of working memory. Therefore, voiced warnings should probably use shorter length statements.

As referred to earlier, Barzegar and Wogalter (1998a; 1998b) conducted a study on the effects of sound parameters on intended carefulness ratings for voiced signal words. In particular, the researchers examined the effects of sex of participant, sex of speaker, sound level (low, high), and voice style (monotone, emotional, whisper). Barzegar and Wogalter (1998b) also examined type of participant (undergraduate psychology student, community volunteer). The original studies examined all factors as between subjects, except for voice style and signal words, which were repeated measures.

The current study is an expansion of the original Barzegar and Wogalter (1998a, 1998b) research. The intention was to determine whether the previous findings for presentation style would produce similar effects for longer, more complete warning statements. This study examines different sound parameters such as sex of speaker, voice style (monotone, emotional, whisper), and sound level (low, high), with all factors examined as repeated measures. Therefore, participants were exposed to all combinations of the different presentation styles. Again, sex of participant was included to examine any differences in intended carefulness ratings for the different sex participants. The warning statements that were used are presented in Table 1. In general, they consisted of the signal word, hazard type and information to avoid the hazard/danger.

METHOD

Participants

A total of 72 individuals participated. Participants consisted of undergraduate students at North Carolina State

Table 1. Warning Statements Used

Signal Word	Hazard Type	Instructions
1. DANGER	Flammable Material	Keep Fire Away
2. DANGER	Combustible Material	Keep Fire Away
3. DEADLY	Flammable Material	Keep Fire Away
4. DEADLY	Combustible Material	Keep Fire Away
5. CAUTION	Skin Irritant	Wear Gloves and Goggles
6. WARNING	Skin Irritant	Wear Gloves and Goggles
7. STOP	Construction Area	Restricted Entry
8.	Construction Area	Restricted Entry
9. CAUTION	Electrical Hazard	Keep Out
10. WARNING	Electrical Hazard	Keep Out
11. DANGER	Fire	Use Stairs and exit immediately
12.	Fire	Use Stairs and exit immediately

University and volunteers from the several New York and New Jersey communities. The mean age of participants was 33 years of age. The education levels attained by the participants were: 1% completed some high school, 17% completed high school, 49% completed some college or trade school, 13% completed college or trade school, 2% completed some graduate/medical/law school, and 18% completed graduate/medical/law school (e.g., Master's degree, Ph.D., M.D.). The ethnicity/race composition as reported by the participants were 79% Caucasian, 6% were Hispanic, 6% were Middle Eastern, 4% were African American, 4% indicated Multi or Other ethnic/race categories, and 1% were Asian. Ninety-four percent of the participants indicated that English was their primary language. Although nine individuals stated that they have experienced hearing difficulty, only four had a diagnosed hearing problem.

Materials

The warning statements were manipulated to examine the effects of different signal words, the presence and absence of a signal word, and perceived difference between statements containing Flammable Material and Combustible Material. The results of these comparisons will not be detailed in this report.

Thirty six different random orders of the 12 warning statements were created using the Statview Se + Graphics computer program. These warning statement lists were used to create the audio recordings of the warning statements voiced by each speaker in the different presentation styles. Three male and three female speakers were used to produce the recordings. Each speaker created two recordings (A and B) of each voice style (monotone, emotional, whisper). The monotone recordings were voiced in a dull, flat voice. For the emotional recordings, speakers were instructed to envision a scenario in which a loved one was about to walk into a

hazardous or harmful situation. Then they were instructed to voice the words in a manner that would capture the attention of a loved one and indicate the presence of an immediate hazard. The whisper recordings were created by speaking the statements in a soft, quiet voice. The recordings were produced with careful effort to maintain the voice within a similar decibel range.

The statements were recorded in a sound chamber (to reduce the effects of background noise) using a Marantz PMD201 professional portable cassette recorder, an Audio Technica ATR 30 vocal/instrument microphone, 18 TDK DS-X60 audio cassettes, Sharp boom box model QT-CD5(GM), and Koss TD/60 enclosed-ear headphones.

Two 6 X 6 Latin squares were produced, one representing the different speakers (Males 1 to 3 and Females 1 to 3) and the other representing the different voice styles and sound levels (Monotone Low, Monotone High, Emotional Low, Emotional High, Whisper Low, and Whisper High). A row of the each Latin square was combined to determine the conditions and the order in which each was presented. These combinations were repeated twice for each participant, once using the A recordings for each speaker then the B recordings. Different recordings were used for each condition in an attempt to verify that the statements were heard in a different order. A schedule was produced to confirm that all combinations of the conditions were run.

Procedure

Initially, participants were asked to sign a consent form. It was explained to each participant that they would hear a series of 12 recordings. Participants were asked to imagine the following scenario:

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 will hear a series of statements via headphones. Imagine that these statements are being voiced as you navigate through the site.

They were instructed to "Please respond how careful you would be after hearing each statement." Ratings were based on a 9-point Likert-type scale with the following verbal anchors on the even values. The verbal anchors used are as follows: (0) not at all careful, (2) slightly careful, (4) careful, (6) very careful, and (8) extremely careful.

Each participant heard the statements voiced in all voice styles, by male and female speakers, and at both sound levels. The low (approximately 70 dBA) and high (approximately 90dBA) sound levels differed by approximately 20 dBA.

RESULTS

A 2 (Sex of participant) X 2 (Sex of speaker) X 2 (Sound level: low, high) X 3 (Voice style: monotone, emotional, whisper) X 12 (Warning Statements) mixed-model analysis of variance (ANOVA) with all factors manipulated as repeated measures, except Sex of Participant.

The ANOVA showed a significant effect for voice style, $F(2, 140) = 36.72, p < .0001$. Tukey's Honestly Significant Difference (HSD) test showed comparisons among all voice styles were significant (Monotone, $M = 4.27$; Emotional, $M = 5.17$; Whisper, $M = 4.40$). There was also a main effect for sound level, $F(1, 70) = 25.11, p < .0001$. The high sound level ($M = 4.73$) produced significantly higher ratings than the low sound level, ($M = 4.49$). In addition to the main effects noted for the sound parameters, there was also a main effect for the warning statements, $F(11, 770) = 75.12, p < .0001$. Specific analyses regarding the warning statements will not be discussed in this report.

In addition, the ANOVA also indicated the presence of a significant interaction involving voice style and sex of speaker, $F(2, 140) = 9.90, p < .0001$. For the emotional voice style, female speakers produced higher intended carefulness ratings than the males did. However, for the whisper voice style, males produced higher ratings than the females. The means for intended carefulness ratings for this interaction are shown in Table 2.

Table 2. Intended Carefulness Means as a Function of Voice Style and Sex of Speaker

Sex of Speaker	Voice Style			mean
	Monotone	Emotional	Whisper	
Male	4.27	5.03	4.47	4.59
Female	4.28	5.31	4.32	4.64
mean	4.27	5.17	4.40	

DISCUSSION

The results of this study indicate that the emotional voice style produces the highest intended carefulness ratings compared to the other two voice styles. In addition, the whisper voice style produced higher ratings than the monotone voice style. The sex of speaker interaction with voice style indicated that the emotional voice spoken by female speakers produced the highest carefulness ratings.

The results also showed that statements presented in the high (louder) sound level produced greater ratings than those presented in the low sound level. In the previous Barzegar and Wogalter (1998a; 1998b) studies, no such effect was found. However, in the previous study, sound level was a between subjects variable as opposed to the current repeated measures design, where participants were able to hear both sound levels and compare them.

Research has indicated that voice warnings produce high levels of compliance (e.g., Racicot, Kalsher, & Simpson,

1994; Wogalter et al., 1993; Wogalter & Young, 1991). However, careful consideration of the situations in which auditory warnings can be effective is imperative. Environments in which there is a lot of visual clutter might benefit from the use of auditory warnings. As stated earlier, auditory warnings are omnidirectional and, therefore, do not require the receiver's attention to be specifically directed toward the warning. However, there are situations or environments in which auditory warnings might not be appropriate or useful. For example, the presence of a high level of background noise might mask an auditory warning.

Arguments might be raised as to the benefit of voiced warnings with respect to language skills. Some receivers of the warning information might not understand the language in which the warning is presented. It is hoped that the presentation style (e.g., voice style) will provide, at least, some cue reflecting the level of urgency associated with the warning.

In addition to those included in the current study, there are several additional parameters of sound that need to be examined. There are numerous other voice styles that can be examined to determine the most effective types for articulating warning information. Additional studies might also be performed to examine environments in which auditory warnings might be specifically applicable. A clearer understanding of factors that effectively change behavior in response to voiced warnings, considering both sound characteristics and information content may benefit safety.

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