Acceptability of Evacuation Instruction Fire Warnings

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The present research examined a set of fire warning statements that could be used to facilitate evacuation of a multi-story building by manipulating the statements' wording and order. Participants (N = 105) evaluated how acceptable each of 13 statements would be in a fire emergency. Manipulated in the statements were two types of components: (a) 3 levels of egress immediacy: "exit now," "exit immediately," or none, and (b) 3 levels of egress directives: "use stairs," "do not use elevator," or none. Results showed that participants rated statements containing egress-immediacy and egress-directive components higher than statements without those components. There were no significant differences between the two egress immediacy components or between the two egress directives. An additional component order manipulation showed no effects. Implications and suggestions for future research on warning statement composition are discussed.

INTRODUCTION

Annually, U.S. fire departments responded to over one million fires. About a half million of these were structure fires (Karter, 2010), which were responsible for thousands of deaths and injuries. Because fires have the potential to severely harm, preventing fires and mitigating fire damage are important objectives (Williamson, 2006). Although preventing fires is the best way to safeguard people and property, it is not always possible to prevent them. Therefore, effective warning systems could limit personal injury and property damage.

Most fire warnings in buildings are auditory warnings that use loud but simple auditory signals such as bell, buzzer, or siren tones to alert that a fire is potentially present. The information relayed is limited. The typical fire warning emits a simple sound, but it does not provide much other information that could be useful, such as specific evacuation instructions. Moreover, there could be concurrent signals from other alerts potentially causing confusion. Fire emergencies are typically very noisy environments and stressful situations. One way to add more information to the usual auditory fire alarm is to provide a visual display. New low cost display technologies (e.g., various flat displays and e-paper) enable dynamic electronic displays to be given practically anywhere including on curved surfaces.

These visual displays could provide brief specific evacuation instructions. One benefit of using electronic displays is that messages could be dynamically changed according to the danger present. Strategically placed electronic displays could provide important information when and where it is needed to assist occupants in a safe fire evacuation process. In multi-story buildings, for example, they could be placed near/outside elevators and in hallways.

The specific wording in the message is likely to matter. Research has shown that different signal words connote different levels of hazard (e.g., Chapanis, 1994; Hellier & Edworthy, 2006; Wogalter & Silver, 1995). Kim, Cowley, and Wogalter (2007) found that changes in warning instructions or directives influenced participants' ratings. They specifically found that including emphasis adjectives and qualifiers in warning directives increased compliance intentions. The findings from these studies could be applied to developing appropriate evacuation instructions in fire emergencies. Fire experts recommend that building occupants avoid using elevators in fire emergencies for several reasons including that elevators could malfunction, could go to floors with raging fires, or smoke could become entrapped in the elevator well and envelop the elevator (NFPA, 2011). All public-use elevators have signs near the outside call buttons with text and/or symbol(s) with the intended message not to use the elevator in case of fire, and to use the stairs instead. Despite the pervasiveness of these elevator signs, the specific content of these warnings appears not to have received much attention in warning research. Research on wording to assist children's egress for smoke alarms has begun to develop (e.g., Smith & Wogalter, 2007; Thomas & Bruck, 2010).

Fire evacuation warnings should be brief but be long enough to convey necessary important information (Laughery & Page-Smith, 2006) so that occupants can quickly acquire the message that there is an urgent fire emergency and take a safe course of action. Brevity also relates to the size of the message given by a display. A longer message could produce difficulties. A longer message might need to be scrolled across the display (with some of the message being absent some of the time) or force a reduction in print size to show the entire message within the display's confines (serving to negatively affect legibility). Towards the goal of optimizing the fire evacuation message, several aspects of the presentation and display of fire evacuation warnings may be relevant.

In the present study, two wording variables were manipulated in fire egress (evacuation) instructions. Specifically, the two wording variables were: egress immediacy and egress directive. These factors each had three levels and were systematically varied within a set of

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statements. Measured were participants' ratings of acceptability as fire evacuation messages.

Component order within statements and statement length were also examined.

METHOD

Participants

A total of 105 individuals (58 males, 47 females) from the Raleigh, North Carolina area participated, and the overall mean age of the sample was 28.8 years (*SD* = 14.9). Seventy-two (68.6%) participants were full-time students. Eighty-three (79%) reported English as their native language.

Materials and Procedure

Each participant received a questionnaire consisting of a consent form, demographics questions (e.g., gender, age, education), and questions on various safety-related topics. Participants were told that the intent of this research was to find better ways to alert people in real fire emergencies and get them to respond appropriately. Participants were instructed that the provided fire warnings were presented as part of a potential fire emergency. Participants were asked to rate statements on their acceptability as fire warning statements.

A list of warning statements was generated. All statements started with the key signal term “Fire.” It was given twice (i.e., Fire, Fire) at the beginning of each statement to give a sense of urgency. Some statements included an egress immediacy component to encourage building occupants to evacuate quickly and when present was either "Exit Now" (short version) or "Exit Immediately" (long version). Additionally, some statements included instructions on how to evacuate, i.e., egress directive components, and when present was “Use Stairs” or "Do Not Use the Elevator." The 13 warning statements rated by participants are shown in Table 1. Participants were asked to give a rating as to how acceptable each statement was as a fire warning in a multi-story building. A 9-point rating scale was used with the following anchors provided with the even-numbered ratings: *0 = Not all acceptable*, *2 = Somewhat acceptable*, *4 = Acceptable*, *6 = Very acceptable*, and *8 = Extremely acceptable*. Provided next to each statement was a blank where participants recorded their rating. Two orders of statements were used; one was randomized and the other was the reverse order.

RESULTS

Five analyses are described: (1) Descriptive statistics of 13 warning statements, (2) analysis of 13 warning statements, (3) order analysis, (4) factorial analysis, and (5) statement length.

13 Warning Statements

The first analysis describes statistics among the 13 warning statements. Table 1 shows the means and standard deviations of the ratings for warning statements arranged in order from highest to lowest mean ratings of acceptability. The highest rated statements were “Fire, Fire, Exit Now, Use Stairs” (*M* = 5.56) and “Fire, Fire, Exit Immediately, Use Stairs” (*M* = 5.44), which were rated near the anchor of "very acceptable." The lowest were “Fire, Fire, Exit Now” (*M* = 3.99) and “Fire, Fire” (*M* = 2.39). The latter two lowest items lack an egress directive component and the lowest also lacks an egress immediacy component. The highest versus the lowest rated statements differed by 3 points on the rating scale, ranging from "somewhat acceptable” to "very acceptable."

Table 1

Mean acceptability ratings and standard deviations of 13 fire statement conditions. Statements are in descending order of means.

Fire Statements	Mean	*SD*
Fire, Fire, Exit Now, Use Stairs	5.56	1.72
Fire, Fire, Exit Immediately, Use Stairs	5.44	2.00
Fire, Fire, Exit Immediately, Do Not Use Elevator	5.27	2.30
Fire, Fire, Exit Now, Do Not Use Elevator, Use Stairs	5.10	2.44
Fire, Fire, Exit Now, Use Stairs, Do Not Use Elevator	4.98	2.47
Fire, Fire, Exit Now, Do Not Use Elevator	4.84	2.04
Fire, Fire, Use Stairs, Do Not Use Elevator	4.80	1.98
Fire, Fire, Do Not Use Elevator, Exit Now	4.54	2.02
Fire, Fire, Use Stairs	4.43	2.08
Fire, Fire, Do Not Use Elevator	4.32	1.84
Fire, Fire, Exit Immediately	4.21	2.00
Fire, Fire, Exit Now	3.99	2.13
Fire, Fire	2.39	2.42

Note. Tukey's HSD = 0.82 at $p = .05$.

Analysis of 13 Warning Statements

The second analysis involved the entire set of 13 warning statements considered as separate conditions. A one-way repeated measures ANOVA revealed a significant effect of statements on rated acceptability, $F(12, 1248) = 21.99$, $MSE = 3.21$, $p < .001$. Tukey’s Honestly Significant Difference (HSD) test was equal to 0.82 at $p = .05$. This number can be used to determine significant differences between means of any chosen statement pairs. If the difference is larger than the HSD then the two means are significantly different, and any difference less than the HSD is not significant. The two highest rated statements were significantly greater than the bottom six statements. The highest rated statement was not significantly higher than the other top six statements. The HSD also revealed that the lowest rated statement (“Fire, Fire” only) was significantly lower than all other statements. Additional significant differences can be found among the intermediate means. In Table 1, it can be seen that the lower rated statements had just one component of egress immediacy or directive. Thus, participants prefer both components being present.

Order Analysis

The third analysis involved statement order. Some statements had identical content but some of the component parts were ordered differently. Examined was whether statements that were identical in content but differing in component order might differ in acceptability ratings. The two statements "Fire, Fire, Do Not Use Elevator, Exit Now" and "Fire, Fire, Exit Now, Do Not Use Elevator" have identical component content but the order of egress immediacy and egress directive components is reversed. There was no difference between these two statements in the ratings, however. There was also no significant difference in the ratings between the two statements: "Fire, Fire, Exit Now, Use Stairs, Do Not Use Elevator" and "Fire, Fire, Exit Now, Do Not Use Elevator, Use Stairs." No other statement orders were analyzed.

Factorial Analysis

The fourth analysis involved a subset of the total warning statements, as shown in Table 2. From the original set of 13 statements, 9 were used to form a 3 (egress immediacy component: none, "Exit Now," and "Exit Immediately") X 3 (egress directive component: none, "Use Stairs," and "Do Not Use Elevator") factorial repeated measures design. The ANOVA for these data show a significant main effect of the egress immediacy on ratings of acceptability, $F(2, 208) = 43.83$, $MSE = 3.33$, $p < .001$. There was also a significant main effect of the egress directive, $F(2, 208) = 40.01$, $MSE = 5.71$, $p < .001$. The interaction of egress immediacy and egress directive factors was also significant, $F(4, 416) = 6.24$, $MSE = 1.72$, $p < .001$. The means for these effects are discussed in the next paragraphs.

Table 2

Statements organized as a function of egress immediacy and egress directive factors.

	Egress Immediacy Components		
Egress Directive Components	None	Exit Now	Exit Immediately
None	Fire, Fire	Fire, Fire, Exit Now	Fire, Fire, Exit Immediately
Use Stairs	Fire, Fire, Use Stairs	Fire, Fire, Exit Now, Use Stairs	Fire, Fire, Exit Immediately, Use Stairs
Do Not Use Elevator	Fire, Fire, Do Not Use Elevator	Fire, Fire, Exit Now, Do Not Use Elevator	Fire, Fire, Exit Immediately, Do Not Use Elevator

Note. Statements included in analysis were ordered: egress immediacy component, egress directive component. Statements in other orders were not included.

In Table 3, the main effect means for egress immediacy are shown along the bottom row. Comparisons among the egress immediacy main effect means indicated that the statements with an egress-immediacy component ("Exit Now" or "Exit Immediately") were rated significantly higher than the statement without an egress immediacy component. The difference between the means for the two egress-immediacy present statements was not significant.

The main effect means for egress directives are shown in the last column of Table 3. Comparisons among the means showed that "Use Stairs" and "Do Not Use Elevator" had significantly higher means than the statement without an egress directive component, but the two egress-directive present statements did not differ significantly from each other.

Figure 1 shows the interaction graphically. To decompose the interaction, each main effect was examined at different levels of the second main effect, using Bonferroni corrections to control for alpha inflation due to the number of tests being conducted. The pattern in the graph largely reflects the main effects described in the prior paragraphs. The interaction appears to be due to the significantly lower ratings for statement "Do Not Use Elevator" with "Exit Now" compared to "Use Stairs" with "Exit Now."

Table 3

Mean acceptability ratings as a function of egress immediacy and egress directive factors.

	Egress Immediacy Components			
Egress Directive Components	None	Exit Now	Exit Immediately	Mean
None	2.39	3.99	4.21	3.53
Use Stairs	4.43	5.56	5.44	5.14
Do Not Use Elevator	4.32	4.84	5.27	4.81
Mean	3.71	4.80	4.97	

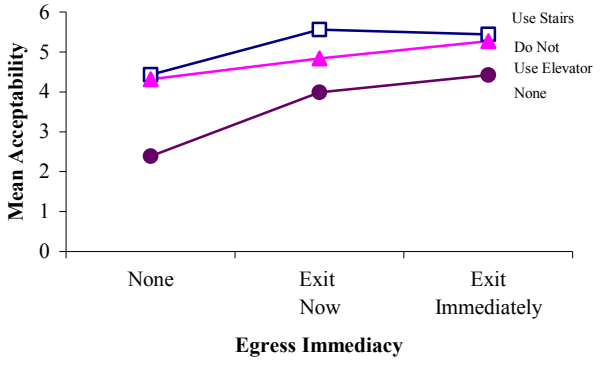

Figure 1. Graphed mean acceptability as a function of egress immediacy and egress directive

Statement Length

The fifth analysis evaluated whether statement length affected the ratings. Statement length was operationally defined as the number of syllables in each statement. Those statements that had the same number of syllables were

collapsed into a group, and the mean acceptability rating was computed for each group. For instance, statements "Fire, Fire, Exit Immediately, Use Stairs" and "Fire, Fire, Do Not Use Elevator" both have 11 syllables and had their ratings combined for this analysis. There were nine different groups of syllable counts ranging from two to 16 (not all syllable counts were represented).

Table 4 shows the means and standard deviations of statement ratings arranged by number of syllables, and Figure 2 shows this information graphically. Statements with 16, 14, or 7 syllables received the highest ratings, and the 7-syllable statement had the highest mean. The statement with two syllables received the lowest mean. A one-way repeated measures ANOVA revealed a significant effect of syllable count on acceptability ratings, $F(8, 832) = 29.55$, $MSE = 3.11$, $p < .001$. Tukey's HSD test was found equal to 0.76. The HSD showed that there were no significant differences among the three highest rated syllable groups (16, 14, and 7). Also, the 2-syllable statement produced significantly lower ratings than the others. Other significant differences can be found using the HSD to compare among the intermediate means.

Table 4

Mean acceptability ratings of fire statements as a function of syllable count. Statements are in descending order of syllable count.

Syllable Counts	Mean (*SD*)
16 syllables	5.27 (2.30)
Fire, Fire, Exit Immediately, Do Not Use Elevator	
14 syllables	5.04 (2.36)
Fire, Fire, Exit Now, Do Not Use Elevator, Use Stairs	
Fire, Fire, Exit Now, Use Stairs, Do Not Use Elevator	
12 syllables	4.73 (1.66)
Fire, Fire, Exit Now, Do Not Use Elevator	
Fire, Fire, Do Not Use Elevator, Exit Now	
Fire, Fire, Use Stairs, Do Not Use Elevator	
11 syllables	4.88 (1.58)
Fire, Fire, Exit Immediately, Use Stairs	
Fire, Fire, Do Not Use Elevator	
9 syllables	4.21 (2.00)
Fire, Fire, Exit Immediately	
7 syllables	5.56 (1.72)
Fire, Fire, Exit Now, Use Stairs	
5 syllables	3.99 (2.13)
Fire, Fire, Exit Now	
4 syllables	4.43 (2.08)
Fire, Fire, Use Stairs	
2 syllables	2.39 (2.42)
Fire, Fire	

Note. Tukey's HSD = 0.76 at $p = .05$.

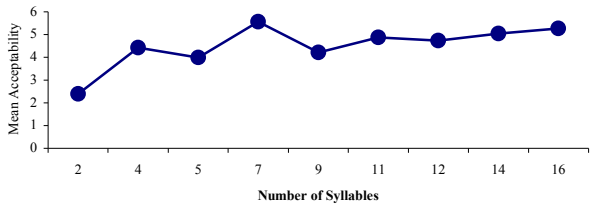

Figure 2. Graphed mean acceptability as a function of statement length based on number of syllables

DISCUSSION

This study examined various types of fire warning statements as part of an early step in determining acceptable fire emergency statements. The results showed that certain statements are considered more acceptable than others.

The factorial analysis of egress immediacy and egress directive components revealed several important findings. The manipulation of both factors significantly affected the ratings. Statements with egress immediacy components received higher ratings compared to the statement without them but the two egress immediacy components ("Exit Now" or "Exit Immediately") did not significantly differ. This is shown in the bottom row of Table 3 and by the separate lines in Figure 1. The two egress immediacy components (now and immediately) are synonyms (e.g., Webster's American Thesaurus College Edition, 2000), and the statements only differed by these two words.

The egress directive factor also influenced ratings. Statements with either of the two explicit egress directives received higher ratings than if absent. The egress directives ("Use Stairs" and "Do Not Use the Elevator") did not significantly differ. This finding is shown in the right column of Table 3 and by the separate lines in Figure 1.

However, not all statement ratings followed the general trend suggested in the overall analyses. This was partly suggested by the significant interaction in the factorial analysis. The interaction appeared due to "Exit Now, Do Not Use Elevator" producing lower ratings in comparison to "Exit Now, Use Stairs." The reason for this effect is not clear. It could be a result of participants considering that "Do Not Use Elevator" (7 syllables) is much a much longer than "Use Stairs" (2 syllables), and they would prefer a shorter warning issued in a fire emergency. Also, the building imagined by participants could have had an effect. The instructions described a multi-story building using the statement warnings, but not all multi-story buildings have an elevator. If the building has no elevator, then it would not make sense to use the directive "Do Not Use Elevator." This different interpretation could result in its lower acceptability ratings for the "Do Not Use Elevator" component. All multi-story buildings have stairs, and "Use Stairs" is a general directive that can be used in buildings with or without an elevator. Future studies might consider re-examining this interaction effect.

Analyses showed that statement length as measured by syllable count indicated that the longer statements tended to receive higher ratings than the shorter statements. The main exception to this is that the 7-syllable statement, which had the highest rating of all lengths, as seen in Table 4 and Figure 2. Moreover, it had a relatively low standard deviation suggesting consistency across participants in their ratings. This particular statement provides the essential details in the shortest presentation. The shortest and most generic statement ("Fire, Fire") had the lowest mean rating and had high variability in ratings. It did not offer much additional information as compared to simple fire alarms, communicating only that fire might exist. Also statements having both an egress immediacy and egress directive component were rated higher than

statements with only one of these two components. Together, these results suggest less acceptability for statements that are too short. It is less clear about longer statements given the sample of statements used in this study.

Component order within statements was manipulated, but no differences were found when the orders of egress immediacy or egress directive components were changed. This suggests that order effects are less strong than statement content.

This study has application implications. While these results provide some empirical guidance in the selection of statements to use as fire signals, these data should not be the only consideration. There are factors that may also play a role when considering real-world warnings. In the case of fire signals, an important consideration is that people exhibit well-learned behaviors, and one of these behaviors is to press the elevator button to go down in a multi-story building. A warning that includes explicit mention of "Do Not Use Elevator" may be necessary to try to break a well-learned behavior to press the elevator button. The "Do Not Use Elevator" is not new knowledge for most everyone except young children. What is necessary, however, is to present it as a reminder at the appropriate time. Thus, despite not being the highest rated statement, the warning decision maker may need to consider using a slightly longer message containing "Do Not Use Elevator." Another consideration is that this research only measured acceptability of visual text warnings. The statement ratings may change if they are auditorily voiced. Future research could examine auditory presentation, alone and in combination with visual presentation. Prior research indicates that a multi-modal presentation of information benefits attention and comprehension (e.g., Cohen, Cohen, Mendat, & Wogalter, 2006), and so multi-modal presentation might be beneficial for fire warnings.

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