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The Effectiveness of an Interactive Warning in a Realistic Product-Use Situation

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ABSTRACT

Warning labels are widely used to convey information about the safe use of products. In an attempt to design better warnings, researchers are exploring factors that influence their effectiveness. One design factor that appears promising is an interactive label that requires manipulation by the consumer using the product. In the present research, the effectiveness of two interactive warning labels (with and without a color component) were compared to a standard label in the context of a realistic product-use task. Additionally, task load was manipulated (low vs. higher). The results showed that the interactive labels were noticed, recalled and complied to more often than the standard on-product label. No effect of increasing task load and adding color to the interactive label was observed. The results indicate that the interactive label is a viable means of facilitating warning effectiveness.

INTRODUCTION

Although warnings are an important means of providing information concerning the safe use of a product, their presence does not necessarily ensure that consumers will use products safely (DeJoy, 1989). As a result, researchers have begun to systematically examine the factors that may influence warning effectiveness. Measures of effectiveness include changes in hazard perception, knowledge, and behavioral compliance. The majority of warnings research has focused on the physical design of warnings. Warning design factors include the attributes of the warning itself (e.g., increasing the size of the warning, adding color and pictorials) and extra-warning characteristics (e.g., proximal location and lack of contextual clutter). However, it is not always the case that changes in intra- and extra-warning characteristics result in increased effectiveness (e.g., DeJoy, 1989).

In order to increase the likelihood that a user will read a warning, and ultimately comply with it, it must first be noticed. One design that has shown promise in increasing noticeability is the interactive warning label, initially examined by Gill, Barbera and Precht (1987). This type of warning requires manipulation prior to (or while) using a product. Research has shown that the interactive label is more noticeable than a conventional on-product label (Frantz and Rhoades, in press; Gill et al., 1987; Hunn and Dingus, 1992; Wogalter, Barlow, and Murphy, 1992).

One explanation for the ability of the interactive label to draw attention (as compared to a non-interactive label) may be related to cognitive theories of mental models (Johnson-Laird, 1983), schemas (Bozinoff, 1981; Brewer and Treyens, 1981), and scripts (Schank and Abelson, 1977). Script theory suggests that after experience in a particular domain, people tend to use behaviors based on that experience in future encounters. With repeated experience, these sets of behavioral sequences become well-learned and become connected into larger sequences of behavior, and are theorized to occur automatically without much conscious thought. Therefore, if a person is familiar with a product, most behaviors associated with that product will be driven by scripted sequences of actions. In order to "break" these script-driven processes, some sort of non-scripted component needs to be introduced into the situation. Because the physical manipulation of an interactive label is a novel behavior, it may serve to break into or interrupt the individual's script, making it more likely that the individual will notice, read, and comply with the warning than without the interruption.

Although research has shown that interactive warnings can be effective in drawing attention to (i.e., noticing) warning information, research on its potential to produce behavioral compliance is less clear cut. For example, both Gill et al. (1987) and Hunn and Dingus (1992) found no advantage for an interactive warning in promoting compliance, whereas, two recent studies (e.g., Frantz and Rhoades, in press; Wogalter et al., 1992) have shown a beneficial effect of interactive labels on compliance. Closer inspection of these studies, however, shows that variations in experimental procedures may, at least in part, account for the observed differences in behavioral compliance. The procedures differed with respect to whether the task mirrored realistic product-use conditions, and the degree of familiarity the participants were likely to be with the products and tasks. While it is difficult to disentangle the specific reasons for the differing results between studies, particularly when numerous variables differed between experiments, it is important to re-test the concept of label interactivity because it holds potential promise for increasing warning effectiveness. The most appropriate follow-up test would employ an interactive warning label in conjunction with a familiar consumer product in a realistic product-use situation. In addition, an incidental exposure paradigm should be used in which the experimental situation does not draw explicit attention to the product and warning to assure external validity. Therefore, one purpose of the present study was to examine the effectiveness of two kinds of warnings (conventional tag vs. interactive) on a familiar product (an electrical extension cord) under incidental exposure conditions within a set of tasks that consumers might perform in the home or at work (i.e., realistic product-use conditions).

A second purpose of the study was to examine the effect of task load on warning noticeability and compliance. Task load refers to the number of tasks an individual is carrying out at any given time. Several theories of human information processing posit that an increased level of task load can negatively impact performance (Wickens, 1989). A similar

decrement might be expected for warning-related behaviors. Specifically, if an individual is carrying out several tasks at once (e.g., reading instructions, assembling parts, or talking on the phone), increased task load may result in a failure to notice, read, and comply with a warning.

Before the present study was performed, a pilot study was used to make an initial examination of the potential effect of task load on noticing, reading, and complying with a warning. Participants were asked to plug the electrical cord of various products such as a TV and videocassette recorder (VCR) into outlets using a set of extension cords. The cords contained safety information about their proper use. Under the increased task load condition, participants had to insert a videotape into a VCR, rewind the tape, and then cue it to a specified position. It had been expected that participants in the increased task load condition would be thinking about the secondary task (i.e., cueing the tape) as they were plugging in the products (i.e., primary task), which would decrease the likelihood that they would see, read, and comply with the warning. Nevertheless, the task load manipulation failed to show any effect. One potential explanation for this null finding is that the two tasks occurred in serial order, and not simultaneously. Thus, the extra task might have had no effect during the time participants were using the extension cords. In the present study, another task load manipulation was developed in which the additional (secondary) task was expected to be performed simultaneously with the primary task.

Another issue was examined in the present study - the possible influence of color in a warning. The presence of color might enhance the noticeability of a warning. Most studies concerned with color in the warning literature have measured people's preference and the level of connoted hazard of various colors, but surprisingly, color has received very little systematic investigation in behavioral compliance research. One study by Wogalter, Godfrey, Fontenelle, Desaulniers, Rothstein, and Laughery (1987) showed that a sign with color on a water fountain (that warned of contaminants) was more effective in dissuading drinking than a sign without color. However, color was only one of several enhancements made to the color-present sign; the size of the warning was increased and a pictorial was added as well. Therefore, it is difficult to determine from the Wogalter et al. (1987) study whether and how much influence color had in facilitating compliance. Thus, a third purpose of the present study was to isolate a potential effect of color by comparing an interactive warning label with color (bright safety orange background) to the same label without color (white background) on warning effectiveness measures.

In summary, three variables were manipulated in the present experiment: label type, task load and color. Three dependent measures were used to assess warning effectiveness: (1) noticing, (2) reading, and (3) complying. It was hypothesized that an interactive colored warning label under lower task load conditions would be most effective.

METHOD

Participants

One hundred twenty undergraduates at Rensselaer Polytechnic Institute participated in the study. They received credit toward an introductory psychology course in which they were enrolled. Participants were randomly assigned, in equal proportions, to one of eight experimental conditions.

Design

A 2 Task Load (Low, Increased) x 4 Label Type (No Label Control, Tag, Interactive with Color-Absent, Interactive with Color-Present) between-subjects factorial design was used. Three dependent variables were examined: noticing the warning label, recall of the warning content (as an indicant of reading), and behavioral compliance. Noticing and recall were assessed by items on a post-task questionnaire. Compliance was assessed by observing whether the participants' performed the safety behaviors directed by the warning.

Materials

Four sets of white extension cords were used. Each cord had a removable outlet cover which was permanently attached near the female receptacle of an extension cord. The cover was designed to fit into the female receptacle to prevent shock when the female receptable of the cord was not in use. The original manufacturers warning was located on the plastic outlet cover, molded in raised white text on a white background. The original manufacturers warning was removed due to its low visibility and readability (i.e., small raised white letters on a white background).

The four pairs of extension cords differed only in terms of the presence, location, and color of the warning. In the No-Label (Control) condition, there was no warning information provided anywhere on the cords. In the Tag condition, the warning label was permanently attached to the extension cord five cm above the female receptacle. In the two interactive conditions, the warning label was affixed to the outlet cover on the female receptacle. The two interactive labels were identical except for the use of color. The redesigned warning contained information about potential fire and electrical hazards associated with plugging too many products into the extension cords. Figure 1 shows the label used in the three warnings-present conditions.

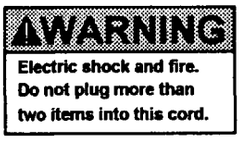

Figure 1. Warning Label used in the Three Warning-Present Conditions. The Gray Shading Represents Orange Color used in the Tag and Interactive Color-Present Conditions. In the Interactive Color-Absent Condition, the Background was White.

The text on all of the warning labels occupied a space of 3.8 cm x 2.2 cm. The font used for the signal word and warning instructions was 18-point sans serif and 8-point sans serif, respectively. The signal word (WARNING) was printed in black text on a white background (Color-Absent condition) and in black text on a bright, highly saturated safety orange background (Tag and Color-Present conditions). In addition, a signal icon (i.e., exclamation point surrounded by a triangle) was located to the left of the signal word.

Procedure

Participants were initally told they would be evaluating instructional media. Each participant was led into a room in which a TV, VCR, and videotape rewinder were set up on a small table. The lights in the room were turned off and the equipment was intentionally left unplugged to make the room appear as if it was not properly set up for the experiment. Upon entering the room, the experimenter turned on the lights and gave the participant an informed consent form to complete. The experimenter then left the room for a few seconds and returned with a pair of extension cords (all conditions) and a small battery operated tape player (Increased Task Load condition only) and casually placed the extension cords on a chair about 1 m from the video equipment and the tape player on a table in front of the participant.

Upon examining the equipment, the experimenter remarked that he had left the videotape in another room and would have to retrieve it. The experimenter then explained what the participant would be asked to do. Participants in the Low Task Load condition were told that they would be watching an instructional videotape about job training and then would complete two questionnaires. Participants in the Increased Task Load group were told that they would be listening to an audiotaped lecture (concerning industrial control rooms), then would watch an instructional videotape, and would later complete two questionnaires.

In the Increased Task Load condition, the experimenter started the audiotape and told the participant that he would return shortly with the videotape. The Low Task Load condition lacked the audio tape and all procedures associated with it. Before exiting the room, the experimenter asked each participant (regardless of condition) if he or she would mind "helping out" by plugging in the television, VCR and videotape rewinder. For those participants in the Increased Task Load condition, this task was to be carried out while they listened to the audiotape. The experimenter then left the room, and after approximately four min had elapsed, the experimenter returned to the room with the videotape.

Finally, participants were taken into another room to complete two post-task questionnaires. The first questionnaire requested various demographic data (e.g., age, gender) and ratings of 18 consumer products including electrical extension cords. The rating questions evaluated three dimensions: perceived hazard, severity of injury and product familiarity. Responses were based on 9-point Likert-type scales anchored with "0" denoting absence of quantity to "8" indicating maximum quantity. The specific questions and numerical and verbal anchors were:

(a) "How hazardous is the product?" with the anchors: (0) not at all hazardous, (2) slightly hazardous, (4) hazardous, (6) very hazardous, and (8) extremely hazardous.
(b) "How severely might you be injured with this product?" with the anchors: (0) not at all severe, (2) slightly severe, (4) severe, (6) very severe, and (8) extremely severe.
(c) "How familiar is the product?" with the anchors: (0) not at all familiar, (2) slightly familiar, (4) familiar, (6) very familiar, and (8) extremely familiar.

For each of the above questions, the products were arranged into three random orders.

The second questionnaire asked participants whether they saw a warning label, and if so, specifically what did it say. Participants in the Increased Task Load condition were also asked to recall the content of the audiotaped lecture.

After completing the questionnaires, participants were debriefed, thanked for their participation, and dismissed. The experimenter then examined the two extension cords to determine how they were connected by the participant. Correct performance (compliance) was operationally defined as plugging in two of the three products into one extension cord and one product into the other extension cord.

RESULTS

Two raters independently scored the open-ended items on the questionnaires. Inter-rater agreement was computed using the formula: agreements/(agreements + disagreements) x 100. Inter-rater agreement for each item ranged from 96% to 100% with a mean of 97% across all items.

A 2 Task Load (Low, Increased) x 4 Label Type (No-Label Control, Tag, Interactive with Color Absent, Interactive with Color Present) between-subjects Multivariate Analysis of Variance (MANOVA) was performed on three dependent variables: noticing, recall, and compliance. Multivariate tests of significance using Hotelling's criterion indicated a main effect of Label Type, $F(9, 326) = 17.48$, $p < .001$, but not Task Load, $F(3, 110) < 1.0$, nor their interaction, $F(9, 326) < 1.0$.

Separate univariate one-way analyses of variance (ANOVAs) were performed on each dependent variable for the significant main effect shown in the MANOVA. Post-hoc tests (i.e., Newman-Keuls Multiple Range Test at an α of .05) were used to compare conditions. The following three sections describe the results of these analyses.

Noticeability of the Warning

There was a significant effect of Label Type on noticing the warning label, $F(3, 116) = 49.67$, $p < .001$. Participants reported seeing both interactive labels ($M = 76.7\%$ and $M = 86.7\%$ for the color absent and present conditions, respectively) significantly more often than the tag label ($M = 16.7\%$) and when no label was present ($M = 0.0\%$). There was no significant difference between the Interactive Color-Absent and Interactive Color-Present conditions, nor between the Tag condition and the No-Label Control condition.

Recall of the Warning Content

There was also a significant effect of Label Type on recall of the warning content, $F(3, 116) = 29.00$, $p < .001$. Participants recalled the content of both interactive labels ($M = 53.3\%$ and $M = 73.3\%$ for the color absent and present conditions, respectively) significantly more often than the tag label ($M = 10.0\%$) and when no label was present ($M = 0.0\%$). There was no significant difference between the Interactive Color-Absent and Interactive Color-Present conditions, nor between the Tag condition and the No-Label Control condition.

Compliance to the Warning

There was a significant effect of Label Type on behavioral

compliance, $F(3, 116) = 14.57$, $p < .001$. Participants complied with both interactive labels ($M = 53.3\%$ and $M = 43.3\%$ for the color absent and present conditions, respectively) significantly more often than the tag label ($M = 6.7\%$) and when no label was present ($M = 0.0\%$). There was no significant difference between the Interactive Color-Absent and Interactive Color-Present conditions, nor between the Tag condition and the No-Label Control condition.

Analysis of Ratings

The results confirmed that participants were highly familiar with the product. Participants gave electrical extension cords a mean familiarity rating of 6.79 (just below the midpoint of the verbal anchors of "very familiar" and "extremely familiar" on the scale). They also assigned extension cords a mean hazard rating of 3.05 (midway between the verbal anchors of "slightly hazardous" and "hazardous" on the scale), and a mean severity of injury rating of 3.08 (between the verbal anchors of "slightly severe" and "severe" on the scale). None of the groups differed with respect to familiarity, hazard or severity of injury ($ps > .05$).

Compliance Contingencies

Of the 54 participants who reported seeing the warning, 43 (80%) were able to recall its contents ($\Phi = .62$, $p < .0001$) and 31 (57%) complied with it ($\Phi = .59$, $p < .0001$). Of the participants who recalled the warning, 72% complied with it ($\Phi = .76$, $p < .0001$). All of the participants who complied with the warning reported seeing it and could correctly recall its content.

DISCUSSION

The results of this study showed that the interactive label was noticed, read (as measured by recall), and complied with more often than a conventional on-product (tag) label. These findings are consistent with those of Frantz and Rhoades (in press) and Wogalter et al. (1992), who also showed a positive effect of interactive warnings. However, this study only partially confirmed the results of Gill et al. (1987) and Hunn and Dingus (1992). Their findings showing increased noticeability were confirmed, but not their findings of no effect on compliance.

While positive effects were found for the interactive label, none was found for the tag relative to the no-label control. Research by Wogalter and Young (in press) has shown another kind of tag label (attached to a small bottle container) to benefit compliance. However, the two kinds of tags were very different. Wogalter and Young's (in press) label, unlike the one used in the present study, required more interaction by the user while using the product.

This study failed to demonstrate an influence of task load on warning compliance. Possibly, the high task load condition (i.e., attending to the audiotape) did not actually produce an increase in cognitive effort at the point in time expected. Post-task questioning indicated that 78% of the participants in this condition reported hearing the contents of the audiotape, but it is not clear whether they were listening to the tape at the precise moment they were plugging in the electrical equipment. As task load has been found to influence performance in a variety of other tasks, additional research on its effect on warning compliance is needed. Some other potential task load manipulations might include having participants simultaneously attend to an important telephone conversation concurrent with the warning-related task or constructing a situation where performance speed is emphasized. If task load is found to have an impact on warning effectiveness, steps should be taken to design warnings that will attract a user's undivided attention and persuade them that compliance is a most important primary task.

The presence of color did not significantly enhance the interactive warning's effectiveness. However, there was a (non-significant) trend favoring color for noticeability and recall, but not for compliance. One possible explanation for this is that the strong effect of the interactive label might have mitigated any additional effect of color. As was noted in the Introduction, research showing effects of color on compliance has been sparse. Additional research is needed to determine not only the effect of color (its presence versus absence), but also the effects of different hues, brightness and saturation on measures of warning effectiveness.

This and other research indicates that interactive warnings are useful in conveying safety information. However, an important question that remains is whether consumers would accept and purchase products with interactive warning labels. By its very nature, the interactive design is intrusive, by purpose interrupting task performance. According to script theory this interruption is necessary to break into people's highly familiar sequence of actions. Thus, a balance probably needs to be maintained between too much intrusiveness and not enough. How such a balance could be determined and achieved is an important topic of future research.

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