Product Manual Safety Warnings: The Effects of Ordering

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ABSTRACT

This study examined whether the ordering or sequencing of hazard warnings in product manuals affects users' acquisition of safety information. Participants were given one of five manuals that differed only in the warning sequencing. Warnings were ordered according to importance, obviousness, nonobviousness, the manufacturer's (original) ordering, or no warnings were present. Participants examined the manual for three minutes or had unlimited time. Later, participants were tested on their knowledge of warning-related material. Analysis showed that males and females produced different patterns of results. For males, the manual with the least obvious hazards first was best; for females, the manual with the most obvious hazards first was best. It is suggested that these results may be at partially due to product familiarity. The results indicate that the ordering of warnings can influence the amount of warning information that people acquire and that the best ordering might depend on such factors as the demographics or familiarity of the users.

INTRODUCTION

Some products available for purchase contain hazards that can not be completely designed out. In such cases one might try to guard against the hazards to prevent people from coming in contact with the hazard. Sometimes hazards can neither be designed out or effectively guarded against. In these cases one should warn users (and relevant others). While there is a considerable and growing amount of research on the design of warnings for individual hazards, there has been relatively little research on how to optimally warn about multiple hazards.

One way to communicate multiple hazards is through product manuals. To date, research on the design of warnings in product manuals has been surprisingly limited. For example, Young and Wogalter (1990) found that manuals with both conspicuous print warnings and icons increased warning comprehension and memory compared to manuals without these characteristics.

Research has also been conducted examining how warning placement on a product or in product manuals affects compliance. For example, research has shown that placing safety warnings before a set of instructions yields to higher compliance than warnings placed after the instructions (Wogalter, Godfrey, Fontenelle, Desaulniers, Rothstein, & Laughery, 1987).

Strawbridge (1988) found that embedding critical safety information within a warning section reduces compliance rates compared to placing the important information first. Strawbridge suggested that in the embedded condition participants stopped viewing the label after reading the less important information and consequently, did not see the more important information. Hence, this work suggests that critical safety information should be distinguished from other less important information to increase the likelihood that it will be read. This distinguishing aspect might be accomplished by moving the important information into its own label area, separating it with the use of white space, or by presenting the most critical information first.

Studies have also been conducted examining how the placement of certain types of warnings (e.g., obvious vs. nonobvious) in a list within product manuals affects people's willingness to completely read the warnings. Using focus groups, Showers, Celuch, and Lust (1993) found that obvious warnings placed first in a list had the potential of offending consumers' intelligence. The authors noted that this ordering might possibly deter the reading of important information located further down the list. However, in a follow up experiment, Lust, Celuch, and Showers (1995) could not confirm the results found in the focus group study.

These last few studies suggest that the order in which warnings are presented might affect the likelihood of reading the most important information. Taking this into consideration, Vigilante and Wogalter (1997) attempted to produce an ordering of warnings based on importance. The authors had participants order warning statements taken from various power tool manuals based on how important they believed each statement was for the safe operation of the tool. The results produced a statement ordering (based on mean

ranks) that could be predicted by participants' ratings of importance, severity of potential injury, and likelihood of injury. The authors suggested that these orderings may be used to increase the likelihood that important safety information will be read.

In the present study, five product manual conditions (Importance-ordering, Obvious-ordering, Nonobvious-ordering, Original-ordering, and No-warnings) were used to determine whether sequencing the warnings by important in the manuals increases knowledge acquisition performance. The amount of time participants were given to examine a manual was also manipulated to determine its effect on knowledge acquisition. Participants were either given 3 minutes in which to examine a manual or all the time they desired. Knowledge acquisition performance was assessed by the amount of product related safety information recalled after exposure to a manual. The study also attempted to reexamine Showers et al.'s (1993) finding that obvious warnings presented first in a product manual will deter people from reading the entire list of warnings, and if so, a lower level of knowledge acquisition should be shown. Finally, the study attempted to demonstrate that lists of warnings in manuals can be improved in order to increase the amount of safety information conveyed to users.

METHOD

Design

This experiment was a 5 (manual) X 2 (time exposure) X 2 (gender) between subjects factorial design. Performance on a (open-ended) knowledge test was measured.

Participants

One-hundred fifty undergraduates participated in the experiment for research credit in their introductory psychology courses (61% males). Ages ranged from 17 to 47 years old (M = 20 yrs, SD = 4.).

Materials

Five manuals were constructed based on an actual product manual for a drywall screw driver. For a realistic appearance, the manuals were formatted exactly like the original. The manual contained a picture of a drywall screw driver on the front cover along with the tools specifications. Included within the manual were diagrams of the tools parts, functions, and accessories. The 12-page manuals contained information on the safe assembly, use, and maintenance of the tool, as well as the tool's warranty. The only differences between the five manuals were the second, third and fourth pages which listed the warning in different specific orders. The exception was the no-warnings (control) condition which lacked warnings.

The first ordering of warnings, Importance-ordering, was developed using data from earlier research by Vigilante and Wogalter (1997). In this study, participants ranked order a set of 34 warnings based on how important each warning was for the safe operation of the drywall screw driver.

The second and third ordering of the warnings were based on the dimension of obviousness. A pilot study was conducted to determine these orderings. In the pilot study 30 participants rated each of the 34 safety warnings on the following scale:

> To what extent is the information *obvious* given what the product is and how it is used? In other words, would the information supplied in the statement be already apparent to a first time user (0 = not all obvious, 2 = slightly obvious, 4 = obvious, 6 = very obvious, 8 = extremely obvious)?

This rating was used to assess the obviousness of the hazard described by the warning, not the obviousness of the warning itself. Based on the mean ratings of the statements, the warnings were then ordered into two lists. The Obvious-ordering list had the most obvious warnings first followed by warnings with decreasing levels of obviousness. The third Nonobvious-ordering list had the exact opposite ordering with the least obvious warning presented first followed by warnings with increasing levels of obviousness.

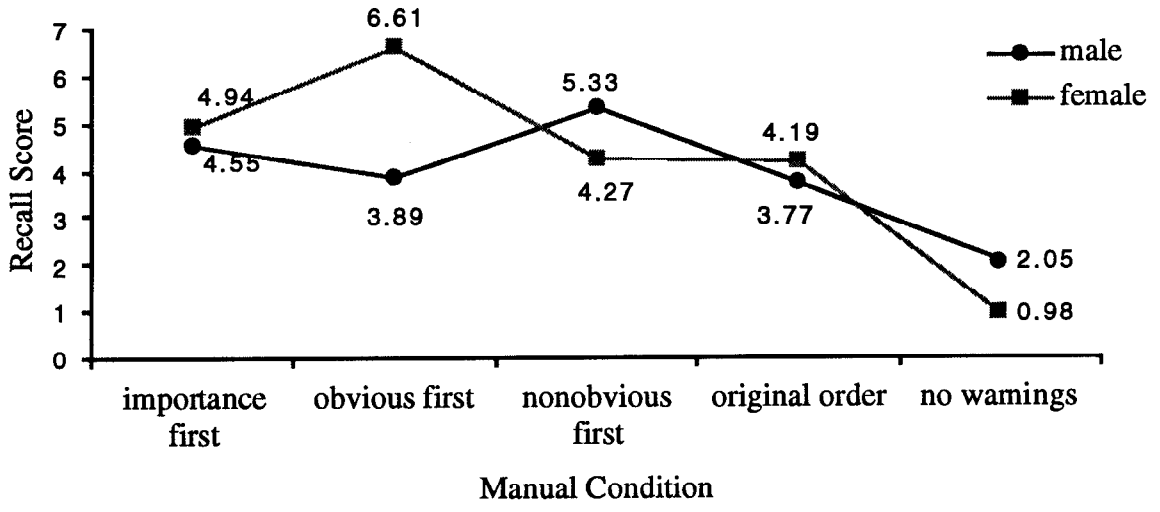
The Original-ordering list was based on the seemingly random ordering of the warnings in the original drywall screw driver product manual. The control condition listed no warnings in the product manual.

Procedure

Participants were seated in a room and instructed that they were taking part in a usability study of a newly designed drywall screw driver; and they would be taken into a second room where they would be videotaped performing several tasks with the tool. Participants were then instructed that, before going into the next room, they had to be given a product manual for the screw driver as part of their informed consent. To enhance the realism and participants' belief that there was some risk involved, participants were told they had the right to freely withdraw from the study at any time should they feel overwhelmed or endangered by the tasks they were asked to perform.

Participants were then given a consent form and a demographic questionnaire (asking about gender, age, educational level, and ethnicity/race, drywall screw driver familiarity, and power tool familiarity and usage). Participants were assigned randomly to conditions and given one of the manuals and allowed to examine it for either 3 minutes or until they were satisfied, after which the manual

Figure 1. ***Mean recall as a function of product manual condition and gender*** *(Males: n = 92; Females: n = 58)*



was removed. The experimenter began timing when the participant was first handed the manual and stopped timing when the manual was removed. After removing the manual, the experimenter administered the open-ended knowledge test. The test consisted of a form which presented 40 blank lines allowing participants to write as much of the safety information that they could remember about a drywall screw driver.

After completing the knowledge test, participants were questioned about their beliefs concerning the purpose of the experiment. If participants indicated that they believed the research involved anything other than power-tool use, their data was eliminated (e.g., those participants expressing that they knew the study was measuring warning recall). Eight participants were eliminated from the data analysis for this reason. At completion of the procedure, participants were debriefed regarding the purpose of the experiment.

RESULTS

Two judges, blind to experimental conditions, scored participants' test responses. Scoring was conducted in such a way that each warning was worth one point totaling 34 possible points. Each warning was divided into sections that were comprised of an important part of that warning. For example, the following warning contains three important parts:

> "Maintain cords with care. / Inspect tool cord periodically and, if damaged, have it repaired by authorized service facility. / Inspect extension cord periodically and replace if damaged."

For this particular warning, participants were given one third point for each part of the warning they recalled and one point if they recalled all three parts. Each warning contained a minimum of one part and a maximum of six parts. Participants were awarded a portion of a point depending on what they recalled correctly. Scoring was considered lenient in that points were awarded if the gist of the warning section was recalled; the warning section did not need to be recalled verbatim.

Inter-rater reliability was determined by correlating the sets of participant total scores from the two judges. The inter-rater reliability coefficient (r) was .95 ($N = 150, p < .0001$).

Due to unequal cell sizes, Least Square (LS) Means were used in all ANOVAs and Type III sums of squares were computed to determine significant main effects and interactions. The ANOVAs were followed by Fisher's Least Significant Difference (LSD) tests to determine if cell means significantly differed from one another.

A 5 (Manual) X 2 (Time) X 2 (Gender) analysis of variance (ANOVA) on the knowledge test scores showed a significant main effect of Manual, $F(4, 130) = 11.51$, $p < .001$, but not of Time or Gender. Paired comparisons among the manual condition means indicated that individuals in the

four warnings-present conditions reported significantly more safety information than individuals in the No warnings condition, $ps < .05$. These means can be seen in Figure 1. The analysis also showed a significant Manual X Gender interaction, $F(4, 130) = 2.64$, $p < .05$. As Figure 1 shows, females recalled significantly more warnings than males in the obvious first condition, $p < .05$. No other gender differences were significant in this analysis, $ps > .05$.

To further explore whether there are differential effects within a gender, additional analyses were conducted for males and females separately. These analysis revealed that: (1) participants in the four warnings-present manual conditions reported significantly more safety information than participants in the warnings absent (no-warning) manual condition (as indicated in the previous analysis); (2) males in the Non-obvious first condition reported significantly more warnings than males in the Original ordering condition, $p < .05$; and (3) females in the Obvious first condition reported significantly more warnings than females in the Original and Non-obvious first conditions, $ps < .05$. No other differences were significant, $ps > .05$.

Additionally, males ($M = 4.37$, $SD = 1.89$) rated themselves more familiar with power tools in general than females ($M = 1.72$, $SD = 1.36$), $t\ (148) = 9.24$, $p < .0001$. Males ($M = 2.22$, $SD = 2.05$) also rated themselves more familiar with drywall screw drivers than females ($M = 0.57$, $SD = 0.93$), $t\ (148) = 5.746$, $p < .0001$. Males also indicated using power tools ($M = 3.51$, $SD = 1.74$) significantly more often than females ($M = 1.17$, $SD = 1.09$), $t\ (148) = 9.158$, $p < .0001$.

DISCUSSION

The results indicate that people who were exposed to the warnings, listed in any order, obtained more hazard information than people who were not exposed to warnings. This finding is not unexpected and supports the value of including such information in product manuals.

The results also indicate that the amount of safety information reported on the test depended on the participant's gender. When the non-obvious warnings were listed first, males recalled more hazard information than when the warnings were listed in their original order. This suggests that in general males, who also report being relatively familiar with power tools, obtain more hazard information when they are presented with information that they do not know first. However, females given a manual with the obvious warnings listed first recalled significantly more hazard information than those given a manual with non-obvious warnings listed first and the original ordering conditions. This finding is a little harder to interpret.

Possibly the obvious warnings were not as obvious to the females as they were to the males. This is supported by the finding that females were in general less familiar with power tools. The obvious warnings also tended to be simpler and easier to read than the less obvious warnings. This can be seen by comparing the warnings in Table 1, which presents a sample of the most and least obvious warnings. respectively. Other data not discussed in this report indicated that females reported reading through the same number of warnings across manual conditions (Vigilante, 1997). Also, for females in the unlimited time condition, the time taken to examine the manuals did not differ across the five manual conditions. These findings suggest that females were reading the same amount of information across the different manual conditions.

Thus in the Obvious warnings first condition, females may have been able to recall more of the information because it was not necessarily obvious to them and it was simpler to read than the information presented first in the other conditions. This assumes that the ordering of safety information is not a major factor in encouraging persons unfamiliar with power tools to read through the warnings. This conclusion also implies the need to keep safety information as simple and as easy to read while still communicating the necessary information.

The particular warnings information recalled by males and females in the Obvious First condition support the above notions. Females in the Obvious First condition recalled more information than males from the most obvious warnings. Males, however, recalled more than twice as much information from the least obvious warnings.

The results of this study suggest that the ordering of safety warnings can affect knowledge acquisition. The specific parameters for the best warning sequence appears to be complex. The finding that gender is a factor underscores the need to consider the target audience when designing warning material.

Most users of products have at least some familiarity with their use. Unfortunately, these users are least likely to look for and read product warnings (Godfrey & Laughery, 1984). However, what might possibly attract their attention is information that they might not know about. If familiar users could anticipate information in manuals being ordered with the least obvious (unknown) information first, they might be more likely to at least scan the material to glean new information. Therefore, we conclude that ordering warnings with the least known information first might be the best method overall in decreasing the possibility for injury in the entire user population.

Additional investigations on the beliefs and behaviors of users is needed to determine whether the present results generalize to other groups of individuals, situations, products,

Table 1. *The Four Least Obvious and the Four Most Obvious Warnings (from the total set of 34).*

Least Obvious

1. Voltage warning: Guard against electrical shock by preventing body contact with grounded surfaces;
2. Keep handles dry, clean, and free from oil and grease;
3. Use right tool: Do not force a small tool or attachment to do the job of a heavy duty tool;
4. Driving screws into electrical wiring in walls, ceilings, or other areas can cause bit to become electrically live

Most Obvious

1. Do not operate tool while under the influence of drugs, alcohol, or any medications;
2. Do not use power tool in damp or wet locations expose to rain;
3. Do not wear loose clothing or jewelry that can get caught in moving parts;
4. Do not use tool if the switch does not turn tool on and off.

tasks, and environments. Recent technological developments have enabled access to information on the World Wide Web where customized manuals could be produced depending on the characteristics of the user to manage the information. Based on information provided by users, the manual could be a dynamic changeable entity depending on users' needs. Determining what kinds of information users need most is an area that is rich in opportunities for research.

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