

Compliance and Recall of Operator Manual Instructions: The Use of Supplemental Voice and Print Directives and Warnings

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Abstract. The present research investigated the effect of supplemental voice and print messages on compliance to and recall of operator manual warnings. Two types of message were presented. Either the message gave specific warning instructions or directed users to a specific location in the operators manual where the instructions were printed. Results show that the supplemental voice and print messages increased compliance behavior compared to a group exposed only to the manual. The voice message produced the greatest recall compared to print or no supplement. There was no effect of the warning vs. directive manipulation. The results have implications for the delivery of warning instructions in operator manuals, and support the use of supplemental voice and print messages to communicate warning information.

1. Introduction

Ideally manufacturers will design out all of the potential hazards associated with the use of their products. However, sometimes this is not possible so the manufacturer presents a warning to the product user. Warnings for consumer products are intended to discourage user behaviors which may result in personal injury to the user or damage to the product. Frequently warnings are printed on labels affixed directly to the product. Some warnings however, are found only in the product operators manual.

One problem with placing important safety information in an operators manual is that not all users will read it. Using a self-report survey, Celuch et al. [1] found that persons with prior product experience were less likely to read an operators manual. Several studies [2 - 5] have shown that people are more willing to look for warnings associated with less familiar and more hazardous products. Otsubo [5] also found that lower familiarity with a product produced greater warning compliance behavior compared to higher familiarity. In a review of research on consumer product warnings, DeJoy [6] concluded that familiarity beliefs and perceived hazard were the most important factors in warning effectiveness.

Several warning design factors have been identified which increase the likelihood that warning information will be communicated, both on printed warning labels and in product operators manuals. Young and Wogalter [7] found that making warning information in operator manuals more salient using larger text, color highlighting and pictorial icons increased comprehension and memory. Attention and compliance to warnings can also be increased by more proximal placement (both spatially and temporally) of the warning message to the task [8] or by actually having the warning physically interfere with task completion [9 - 11].

Presenting warning information using the auditory modality may also lead to greater warning attention and compliance. Kroemer et al. [12] note that auditory signals are better than visual displays when a message must attract attention. They define active warnings (auditory, voice) as those which serve as an alerting device to warn humans of impending danger. In contrast, passive warnings (printed signs, instructions in an owners manual) rely on people's recognition of the material and the potential dangers. Penney [13] found greater recall for recently-presented information when the information was presented auditorily versus visually. Additionally, two studies using a simulated chemistry task paradigm have shown increased compliance when a warning was presented by voice alone or in combination with a printed warning sign [14, 15].

Other research has shown that supplementing operators manual warnings with a strategically located print directive to read the manual produces greater warning compliance [8]. Additionally, Showers et al. [16] suggest that supplementing printed product manuals with audio- or videotapes which highlight product features and safety precautions encourages the use of product manuals.

The present research investigated whether supplemental voice and print messages in addition to the operators manual would increase compliance. The study also sought to verify findings that have shown product familiarity to be inversely related to warning recall and compliance. Finally, this study attempted to determine whether the effectiveness of supplemental information depends on instruction type. One type presented specific warning instructions as the supplement. The other type presented a directive requesting users to examine a specific location in the manual where the warning instructions are shown.

2. Method

The method involved a computer disk drive installation task similar to that used by Wogalter et al. [8].

2.1. Participants

Fifty-five undergraduates at North Carolina State University between the ages of 17 and 34 years ($M = 21.6$, $SD = 4.0$) participated. All received course credit for participating. Participants were randomly assigned to one of five conditions: print warning, voice warning, print directive, voice directive, and control (no supplemental message).

2.2. Materials

The materials included an Apple Macintosh personal computer, a Fujitsu external disk drive, a plastic protective diskette, a reproduction of the disk drive operators manual, two miniaturized digital voice systems, five cardboard shipping boxes and various kinds of plastic packaging (e.g., plastic wrap, a clear plastic bag, and enough styrofoam packing material to fill the boxes). The disk drive (13.0 x 20.5 x 3.5 cm) was wrapped in the "bubble" plastic and placed, with the operators manual, in the plastic bag. A plastic protective diskette (used for the purpose of protecting the drive head during shipping) was inserted in the drive. The plastic bag was taped closed and placed in the bottom of a shipping box. The box was filled with packing material and taped shut.

The operators manual (21.5 x 14.0 cm) was 14 pages in length and included computer hardware and software requirements and instructions for the setup, use, and maintenance of the disk drive. Pages six and seven of the manual listed precautionary steps (i.e., warning instructions) to be performed before connecting the disk drive to the computer. This printed information in the manual was presented in both pictures and words and instructed the user to: (1) turn off the computer, (2) touch the metal connector on the back of the computer to prevent electrostatic discharge which could damage the disk drive, and (3) eject the transport disk from the drive. These same precautionary steps also served as the content of the supplemental warning instructions or served as the material to which the supplemental directive referred to.

The digital voice systems were taken directly from two relatively inexpensive store-bought greeting cards. Each consisted of a "voice chip" capable of recording and playing back a maximum of ten seconds of auditory information, a small speaker, and some peripheral hardware and switches.

The cardboard shipping boxes were plain white (no printing) and measured 30.5 x 22.9 x 19.1 cm. A different box was used for each experimental condition. For the print conditions, the message (warning or directive) was printed in black, bold, sans serif 24-point font on white paper (10.2 x 17.8 cm) and taped to an inside flap of the box, so that the message would be visible when the box was opened. For the print warning condition the message read, "Please turn off the computer, discharge static electricity and remove the protective diskette before installing the disk drive." The message for the print directive condition read, "Please read pages 6 and 7 of the owners manual before installing the disk drive." For each of the voice conditions (warning or directive) the digital voice recording system was attached to an inside flap of the box with a switch positioned so that when the box was opened the recorded message would play. The messages were in a male voice and played for approximately 9 s at 80 dBA. The wording of the messages was exactly the same as in the corresponding print conditions. In the control condition no supplemental message was presented when the box was opened. The operators manual was present in all conditions, located in the plastic bag with the disk drive.

2.3. Procedure

The computer and an attached printer were located on a desk in the experiment room. The disk drive was packed in the appropriate box and placed on a table about 1.0 m from the desk. Participants were seated in front of the computer, which was powered on prior to the beginning of the session, and told that the box on the table to their right contained a disk drive. They were asked to imagine that they had just purchased the disk drive and brought it home. They were instructed that their task was to remove the disk drive from its shipping box and to connect it to the computer. Participants were given the opportunity to ask questions about the task before they began, but once they started they could not ask any questions. They were told that if they had difficulty to figure it out as best they could on their own. Participants were asked to complete the task as quickly as possible but at the same time to maintain accuracy. When instructed to begin participants stood and walked to the table where the disk drive was located. Immediately upon opening the box, participants in the experimental conditions either heard or saw the supplemental message. Participants were never specifically instructed to read the operators manual except in the two directive conditions where they were told as part of these conditions to read pages six and seven. The experimenter silently observed the participants from about 3.0 m away and recorded whether they complied with the three precautionary instructions listed in the operators manual.

After completing the installation task, participants were given a questionnaire which asked about their experience with personal computers and other electronic equipment (VCRs, stereos). The items included whether they had ever setup or installed each of the above-mentioned types of equipment, either for themselves or helping someone else, and if so, how many times. The questionnaire also asked participants to list all of the precautionary steps that should be taken before connecting the disk drive to the computer and to provide basic demographic information (gender, age, etc.). After completing the questionnaire, participants were debriefed and thanked.

3. Results

All participants were able to connect the disk drive to the computer within ten minutes. Behavioral compliance to and recall of the three precautionary instructions were analyzed separately.

3.1. Compliance Measures

If a participant complied with an instruction they were given a score of "1" otherwise they were given a "0." From these scores compliance percentages were computed for each of the three instructions separately. In addition, a composite score was computed combining the compliance scores for all three instructions. Participants scores were then summed to generate a measure of overall compliance that ranged from 0 to 3.

Across all conditions, compliance rates were very high: 85.5% of all subjects complied with the instruction to turn off the computer, 81.8% discharged static electricity and 69.1% ejected the transport disk before connecting the disk drive. Table 1 shows the percentage of compliance with each instruction and mean overall compliance as function of the five conditions. It is evident from this table that compliance to all three instructions was greater for all experimental conditions than for the control condition.

Table 1. Percentage of compliance with each instruction and mean overall compliance.

Condition	% Turn off computer	% Discharge Static Electricity	% Eject Protective Diskette	Mean Overall Compliance
Manual only (control)	54.6	54.6	63.6	1.73
Manual plus supplemental:				
Print warning	90.0	70.0	90.0	2.50
Voice warning	100.0	58.3	91.7	2.50
Print directive	81.8	81.8	81.8	2.64
Voice directive	100.0	81.8	81.8	2.46

Note. Mean overall compliance reflects the number of instructions (out of 3) to which participants complied.

Compliance to the "turn off the computer" instruction showed a significant effect of conditions, $\chi^2 (4, n=55) = 12.65, p < .05$. Neither the "discharge static electricity" nor the "eject transport diskette" instructions showed a significant effect ($ps > .10$). For the "turn off the computer" instruction, specific comparisons were made between each supplemental message condition and the control condition. Both the voice warning and voice directive conditions produced significantly higher compliance than the manual only condition ($ps < .01$). When the manual only condition was compared to all of the supplemental message conditions combined, the supplemental message conditions showed significantly greater compliance, $\chi^2 (1, n=55) = 10.57, p < .01$.

Using the overall compliance scores, a one-way between-subjects analysis of variance (ANOVA) showed no significant effect of condition, $F(4, 50) = 1.36, p > .10$. However compliance was significantly greater when the manual plus supplement conditions were treated as a single group and compared to the manual only condition, $F(1, 53) = 5.55, p < .05$. Pairwise comparisons between each of the supplemental manual conditions and the control condition showed no significant differences ($ps > .05$).

The overall compliance data were also analyzed by modality of the presented message (i.e., voice vs. print) and whether the message was a warning or a directive. A 2 (auditory vs. visual modality) X 2 (warning vs. directive message) ANOVA showed no significant effects, $ps > .10$.

3.2. Recall Measures

The questionnaire assessed recall of the three precautionary steps. Responses were scored as correct by the experimenter if they had similar meaning to the warning instructions given on pages six and seven of the operators manual. Additional precautions such as "be careful" and "don't drop the disk drive" were considered incorrect. The recall data was analyzed in the same manner as the compliance data.

Table 2 shows the mean recall scores for each condition and the percentage of participants in each condition who correctly recalled each instruction. A one-way between-subjects ANOVA showed no significant effect of conditions on recall, $F(4, 50) = 2.06, p = .10$. An ANOVA combining all experimental conditions into a single group and comparing them to the manual only condition also failed to reach the conventional level of significance, $F(1, 53) = 2.96, p = .09$. However, pairwise comparisons between conditions revealed greater overall recall in the voice warning condition than in the manual only condition, $F(1, 21) = 5.44, p < .05$.

A 2 (modality) X 2 (message type) ANOVA on overall recall revealed a main effect of modality, $F(1, 40) = 4.99, p < .05$. Significantly more instructions were recalled when the supplemental messages were presented by voice than by print. No significant effect of warning versus directive, nor an interaction was found, $ps > .10$.

Table 2. Percentage recall of each instruction and overall recall as a function of condition.

Condition	% Turn off computer	% Discharge Static Electricity	% Eject Diskette	Mean Overall Recall
Manual only (control)	45.5	54.6	9.1	1.09
Manual plus supplemental:				
Print warning	50.0	70.0	20.0	1.40
Voice warning	83.3	83.3	41.7	2.08
Print directive	45.5	72.7	27.7	1.27
Voice directive	81.8	72.7	9.1	1.82

Note. Mean overall recall reflects the number of warning instructions (out of 3) correctly recalled.

Experience setting up computers, stereos, and VCRs was used as a measure of familiarity with electronic equipment. Participants were asked how many times in the past they had "set up" each of these types of equipment, either for themselves or assisting someone else. Experience varied widely among participants. Approximately one-fourth (13 of 55) reported having set up or installed electronic equipment three times or less, whereas a like number reported having done this more than 15 times. Experience with computers alone was just as varied. Twenty-one participants reported no experience setting up or installing a computer, while 16 participants had performed the activity at least three times. Participants were divided into high, medium, and low experience groups. One-way ANOVAs comparing computer experience groups on measures of compliance and recall showed no significant effects. Similar ANOVAs using experience with all

types of electronic equipment as the independent measure also failed to reach statistical significance. Finally other analyses using participants groups divided by a median split on computer and overall electronic experience also yielded no significant effects ($ps > .05$).

4. Discussion

The results show that compliance with operators manual warning instructions can be increased through the use of supplemental messages. Although significant effects were found for only one of the three specific instructions, overall compliance was reliably greater when supplemental warnings and directives accompanied the operators manual. The lack of significant findings for the "discharge static electricity" and the "eject transport diskette" instructions is most likely due to a ceiling effect. The majority of participants in all conditions (including control) complied with all three instructions.

The extremely high compliance rates across all experimental conditions can be attributed to several factors. The temporal and spatial placement of the supplemental messages in the task made it almost impossible not to attend to them. Another possibility is that participants may have behaved more cautiously for fear of damaging an expensive piece of equipment that belonged to someone else. Several participants seemed somewhat intimidated by the task. Upon hearing that they would be connecting something to a computer, a number of them responded with some degree of concern and asked if instructions would be provided.

The results failed to show significant compliance differences due to message modality (voice vs. print) or content (warning vs. directive). However the results did show greater recall of warning instructions when the supplemental message was presented auditorily as opposed to visually. This supports Penney's [17] conclusion that simple sequential items, like warning instructions, are more strongly held in memory if presented in an auditory stream, like speech, than in a visual stream, like print. However, it does not support other research showing that print warnings are better recalled than auditory warnings [18].

Although message type (warning vs. directive) did not differentially affect compliance and recall measures in this experiment they might have different effects in other situations or with other products. For example, if a warning message is long or complex the most effective way to communicate it might be to point out the most salient features of the hazard and then refer the user to another location (such as the operator manuals) for further information.

The lack of compliance differences as a function of product experience was surprising and fails to support previous findings showing an influence of familiarity [2 - 6]. One possible explanation for this finding is that even participants who were experienced and had performed tasks similar to the experimental procedure several times in the past may not have been confident enough to perform the task without the aid of instructions. Additional research is necessary to determine whether confidence is a factor, however.

The present results show increased compliance to a set of precautionary instructions in an operators manual when a supplemental message is delivered compared to when it was not (i.e., the manual only conditions). This supports the finding of Wogalter et al. [8] that the presence of a well placed supplemental message facilitates the likelihood of precautionary behavior. The results supports the idea proposed by Wogalter and Young [14] of using voice chips as a means of presenting warning information. Although the costs to implement voice warnings have dramatically dropped in recent years due to mass production, it is probably still too costly and complicated to implement in very inexpensive, commonly-used consumer products. Nevertheless, voice warnings might be beneficial in situations where cost is less constrained and where the direction of users' visual focus can not be guaranteed.

References

- [1] K.G. Celuch *et al.*, Product owner manuals: An exploratory study of nonreaders versus readers, *Journal of Applied Social Psychology* 22 (1992) 492-507.
- [2] M.S. Wogalter *et al.*, Consumer product warnings: The role of hazard perception, *Journal of Safety Research* 22 (1991) 7-82.
- [3] P. Wright *et al.*, Some factors determining when instructions will be read, *Ergonomics* 25 (1982) 225-227.
- [4] S.S. Godfrey *et al.*, Warning messages: Will the consumer bother to look? *Proceedings of the Human Factors Society 27th Annual Meeting*. Human Factors Society, Santa Monica, CA (1983) pp. 950-954.

- [5] S.M. Otsubo, A behavioral study of warning labels on consumer products: Perceived danger and use of pictographs. *Proceedings of the Human Factors Society 32nd Annual Meeting*. Human Factors Society, Santa Monica, CA (1988) pp. 536-540.
- [6] D.M. DeJoy, Consumer product warnings: Review and analysis of effectiveness research. *Proceedings of the Human Factors Society 33rd Annual Meeting*. Human Factors Society, Santa Monica, CA (1989) pp. 936-939.
- [7] S.L. Young and M.S. Wogalter, Comprehension and memory of instruction manual warnings: Conspicuous print and pictorial icons, *Human Factors* 32 (1990) 637-649.
- [8] M.S. Wogalter *et al.*, Compliance to owner's manuals warnings: The influence of familiarity and the placement of a supplemental directive, *Ergonomics* 38 (1995) 1081-1091.
- [9] J.P. Frantz and T.P. Rhoades, A task-analytic approach to the temporal and spatial placement of product warnings, *Human Factors* 35 (1993) 719-730.
- [10] T.A. Dingus *et al.*, Warning variables affecting personal protective equipment use, *Safety Science* 16 (1993) 655-673.
- [11] R.R. Duffy *et al.*, Interactive warnings: An experimental examination of effectiveness, *International Journal of Industrial Ergonomics* 15 (1995) 159-166.
- [12] K.H.E. Kroemer *et al.*, *Ergonomics: How to design for ease & efficiency*. Prentice-Hall, Englewood Cliffs, NJ, 1994.
- [13] C.G. Penney, Modality effects in short-term verbal memory, *Psychological Bulletin* 82 (1975) 68-84.
- [14] M.S. Wogalter and S.L. Young, Behavioral compliance to voice and print warnings, *Ergonomics* 34 (1991) 79-89.
- [15] M.S. Wogalter *et al.*, Behavioral compliance with warnings: Effects of voice, context and location, *Safety Science* 16 (1993) 637-654.
- [16] L.S. Showers *et al.*, Consumers' use of product owner manuals, *Advancing the Consumer Interest* 4 (1992) 22-28.
- [17] C.G. Penney, Modality effects and the structure of short-term verbal memory, *Memory and Cognition* 17 (1989) 398-422.
- [18] T. Barlow and M.S. Wogalter, Alcoholic beverage warnings in magazine and television advertisements, *Journal of Consumer Research* 20 (1993) 147-156.