ERGONOMICS, 1995, VOL. 38, NO. 6, 1081–1091

Compliance to owner's manual warnings: influence of familiarity and the placement of a supplemental directive

MICHAEL S. WOGALTER

Department of Psychology, North Carolina State University, Raleigh, NC 27695, USA

TODD BARLOW

Monterey Technologies, Inc., Cary, NC 27511, USA

SEAN A. MURPHY

Department of Psychology, Rensselaer Polytechnic Institute, Troy, NY 12180, USA

Keywords: Consumer product safety; Equipment safety; Product labelling; Manuals; Compliance.

This research examined several methods of directing people to warnings in an owner's manual in order to increase compliance behaviour during the installation of a computer disk drive. Seven conditions were examined. In the control condition, the disk drive was accompanied by a basic manual that contained equipment-safety warnings on pages 6 and 7. In another condition, the manual was identical except that the warnings were also reprinted redundantly on page 2 of the manual (which was blank in the basic manual). The remaining five conditions were identical to the redundant-warning condition, except that they also included a supplemental directive that was placed at various locations (on the shipping box, cover page of the manual, accompanying leaflet, disk drive cable, and front of the drive). The directive stated 'Please Read Page 2 of the Owner's Manual Before Connecting the Equipment'. The results show a trend of greater compliance with the redundant-warning (only) manual compared to the basic manual, but the difference was not statistically significant. When the supplemental directive was located most proximally to the equipment and required physical interaction with the warning during the task (front-of-drive condition), compliance was significantly greater than the basic and redundant-warning (only) manual conditions. The results also show that, in general, users with less experience connecting electronic equipment complied more frequently with the warnings than users with greater experience. Additional results indicate that less experienced users were not further influenced by the presence and location of the supplemental directive, but highly experienced users complied more often when the supplemental directive was placed in the more proximal locations. The results are discussed in relation to script theory and to previous research on familiarity. The present study suggests that well-placed safety information can be useful in alerting users with varying levels of experience.

1. Introduction

Many products are being marketed today that have hazards that are not known by consumers. Methods of alerting users to the hazards include placing warnings directly on the product and in accompanying materials such as owner's manuals. Although there

has been a growing body of literature on warnings in recent years, there has been little research on the use of owner's manuals for complex consumer products. In a recent set of experiments, Young and Wogalter (1990) showed that the inclusion of pictorials and increased print salience of warnings in owner's manuals produced greater knowledge and memory of the hazards associated with the equipment. However, no study to date has examined how to increase the likelihood that an owner's manual will be examined. Nor has any study examined how to increase compliance with warnings in owner's manuals.

In many owner's manuals, the warnings are embedded within the installation or other procedural instructions. In this context, the warnings can only help users to avoid personal injury or equipment damage if they examine every step in the instructions. However, some users may not look beyond the first few pages of the manual. One potential way to increase the likelihood that users read and comply with product-related warnings is to place them towards the front of the manual (e.g., inside the cover page). Thus, one question addressed in the present research is whether compliance can be influenced by repeating the warnings at the beginning of the manual, in addition to having them in the context of the instructions.

Some research has already investigated certain aspects of warning placement. Wogalter *et al.* (1987) found that participants performing a chemistry task complied more often to a warning when it was placed at the beginning of a set of procedural instructions than if the warning was placed at the end of the instructions. Strawbridge (1986) found less compliance (shaking the bottle) to a warning embedded in a paragraph of text than to a warning at the beginning of a paragraph. Yet she found that warning position on the label (i.e., on the top, middle or bottom paragraph of the label) had no effect on compliance. Given these equivocal results, it is not clear whether the placement of warnings at the beginning of the manual will improve compliance. However, we would expect that their location at the beginning would make them available to more users—including those who read only the first few pages. Moreover, the redundancy of having the warnings appear both in the front and in the middle might be a factor in facilitating compliance. The inclusion of two sets of warnings ought to increase the likelihood that users will see at least one set while scanning the manual. In addition, if users were to see both sets it might enhance the belief that the warnings were important, which could promote the occurrence of compliance behaviour.

A redundant set of warnings near the front of the manual may be useful for users who open and read at least some parts of the manual, but other users may not open the manual or read any of the instructions (Wright *et al.* 1982). For these users, the placement of the warnings in the manual would make little difference. They may only consult the manual when they are unsuccessful in setting up or using the product. By that time, they may have already damaged the product or sustained personal injury. One common solution to address part of this problem is to include warnings as labels directly on the product. However, some products have an extensive list of hazards or have hazards that are not easily communicated in a warning label. An alternative method is necessary to alert users to the hazards and to encourage them to consult the manual.

One way to increase the likelihood that users will consult the manual is to include an additional note, a supplement directive, that users will see as they unpack the equipment. A supplemental directive could: (a) express, in a few words, the need to look at the most critical contents of the manual (i.e., the warnings), and (b) motivate users who might not look at the manual to do so. The supplemental directive used in the present study is shown in figure 1.

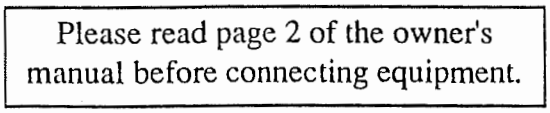

Figure 1. The supplemental directive (which was printed in red) that was placed in various locations.

There are many places that the directive could be located. Some locations might be more effective than others. In a study by Wogalter *et al.* (1991), participants reported that they would be more likely to look for and read product warnings when the warnings were placed in close proximity to the product (e.g., on the product as opposed to in a separate insert or owner's manual). However, these results were derived from self-report questionnaires. In recent research measuring actual behaviour, Frantz and Rhoades (1993) increased compliance by placing a warning on a filing cabinet (advising users to first load the bottom drawers) at locations proximal to where and when the pertinent behaviour would occur during an installation procedure. However, Frantz and Rhoades did not address compliance to warnings in an instruction manual or the utility of a supplemental safety directive.

In the present research, the supplemental directive was positioned at various locations that users would encounter as they installed the equipment. It was expected that more proximal positioning of the supplemental directive (both in terms of close physical distance to the product and of its temporal relation with respect to task performance) would increase compliance with warnings in the owner's manual. Thus, placing it where and when it is needed is likely to be better than other, more distal, locations.

Another variable that might affect the utility of the warnings and safety directives is people's beliefs and perceptions of the product. According to verbal reports, people profess greater willingness to read warnings on less familiar products (Wogalter *et al.* 1991). This suggests that people's previous product experience might modify the utility of the redundant manual warning and supplemental directive manipulations. In addition, script theory (Schank and Abelson 1977) suggests that after repeated experiences in a domain, people's future behaviours in similar contexts are based on generalized procedures gained from the earlier encounters. These scripted behaviours are well-learned and are theorized to occur automatically without much conscious thought. Based on this construct, it would be expected that the behaviour of more experienced electronic-equipment users would be driven by their existing script for the set-up of similar equipment and would lead them to believe that they know the relevant procedures. As a consequence, experienced users would be less likely to consult the owner's manual and read (or heed) the warnings. The current study attempted to 'break' the more experienced users' scripts by introducing a novel element, the supplemental directive, into the installation procedure. It was expected that more proximal locations of the supplemental directive, in terms of distance and time to carrying out the associated procedural steps of the installation task (i.e., where and when the warning information is needed), would be useful in getting experienced users to look at the manual and comply with the warnings. Conversely, it was expected that inexperienced users, having a less-developed script for the domain, would look in the owner's manual regardless of the presence and location of the supplemental directive.

2. Method

2.1. *Participants*

Eighty-four Rensselaer Polytechnic Institute undergraduates participated for credit in their introductory psychology courses. Twelve participants were randomly assigned to each condition.

2.2. *Materials and apparatus*

The materials included an Apple Macintosh microcomputer, a Fujitsu external floppy disk drive, two cardboard boxes, and two different owner's manuals for the disk drive (basic and redundant-warning). Both owner's manuals were adapted from an original manufacturer's owner's manual. These manuals consisted of 13 pages (21·5 × 13·5 cm). Pages 6 and 7 contained safety information that instructed users to perform three behaviours before connecting the external drive to the computer: (1) to turn off the computer, (2) to touch the metal connector on the back of the computer by hand to prevent static elastic discharge that could damage the drive, and (3) to eject the transport disk from the drive.

In the basic manual condition (used as the control condition) the inside cover page (page 2) was blank. The six experimental conditions used the redundant-warning manual in which page 2 repeated the warnings printed on pages 6 and 7 (using an 80%

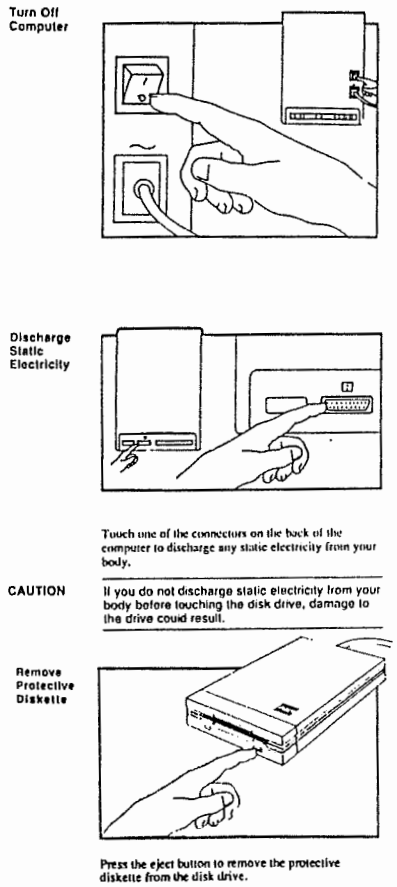

Figure 2. Page 2 of the owner's manual in all conditions except the basic manual condition.

size reduction to fit the space). A representation of the warnings on page 2 of the manual is shown in figure 2.

Five of the six experimental conditions used the redundant-warning manual plus the supplemental directive shown in figure 1. The supplemental directive was located in one of five locations:

(1) Cover Page: on the top portion of the cover of the manual (without obscuring any other information).
(2) Box: on the top of the shipping box.
(3) Leaflet: inside a folded leaflet (21·5 × 13·5 cm) that accompanied the owner's manual with 'Open this First' printed in bold black letters on the cover.
(4) Drive Cable: attached to the cable of the drive.
(5) Front of Drive: attached to the front of the drive and covering the disk drive opening.

The safety directive was printed in a red, bold, san serif 24-point font on a white background (13·8 × 2·6 cm). An example of the supplemental; directive as it appeared in one of the conditions, the cover page, is shown in figure 3. The disk drive and instruction manual were held in a styrofoam packaging box (28 × 19 × 13 cm), which was contained in a plain brown cardboard shipping (60 × 47 × 31 cm).

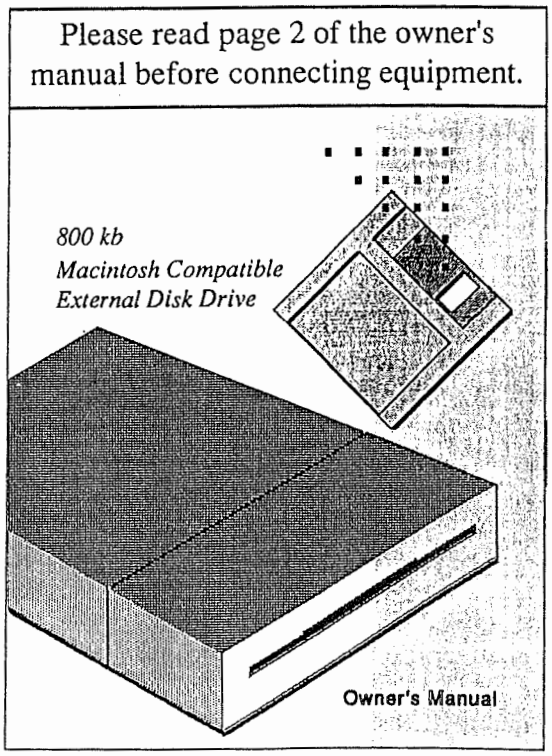

Figure 3. First page of the owner's manual in the condition with the supplemental directive on the cover page.

2.3. *Procedure*

Initially, participants were asked to read and sign a consent form that described the study as investigating the procedures involved in the assembly of various small appliances. Participants were told that their task was to connect a disk drive to the computer. The shipping box containing the drive and manual was located on one table and the computer (which was powered up) was on another table. They were told that they had a limited time to complete the procedure and that once they began, they could not ask any questions. If the participants had any difficulty, they were told to solve the problem on their own. After the experimenter answered any questions, the participants were told to begin. The experimenter recorded whether participants performed the three warning-directed behaviours (turn off the computer, touch the metal connector on the back of the computer, and eject the transport disk) before attaching the disk drive to the computer.

After completing the task, participants completed a questionnaire assessing previous experience with electronic appliances. The questionnaire asked: (a) whether they owned a microcomputer, stereo system, and video cassette recorder (VCR), (b) what devices, if any, were connected to this equipment, and (c) whether they connected and learned to use the equipment themselves or had the aid of another person. After completing the questionnaire, the participants were debriefed and thanked.

3. Results

Compliance (ranging from 0 to 3) was measured by summing the number of behaviours performed by each participant as directed by the warnings in the manual. Table 1 shows the mean compliance score for each condition. A one-way between-subjects ANOVA showed a significant effect of warning conditions $F(6,77) = 2{\cdot}75$, $p < 0{\cdot}05$. Comparisons among the means using Fisher's Least Significant Difference (LSD) test showed significantly lower compliance for the basic manual compared to all of the other conditions except for the redundant-warning manual (only) condition ($ps < 0{\cdot}05$). The only other significant comparison showed that the front-of-drive supplemental directive

Table 1. Compliance as a function of redundant manual warnings and location of the supplemental directive.

Conditions*	Mean compliance score (0–3)	Turned off computer (%)	Grounded plug (%)	Ejected disk (%)
(a) Basic manual	1·08	41·67	33·33	33·33
(b) Redundant-warning only	1·58	58·33	50·00	50·00
Redundant-warning manual plus the supplemental directive on the				
(c) Box	2·25	83·33	66·67	75·00
(d) Cover page	2·25	75·00	75·00	75·00
(e) Leaflet	2·50	83·33	83·33	83·33
(f) Drive cable	2·50	83·33	83·33	83·33
(g) Front of drive	2·75	91·67	100·00	83·33

* In all conditions (including the basic manual condition) the warnings were printed on pages 6 and 7. In all but the basic manual condition, the warnings were also printed redundantly on page 2 of the manual.

(plus redundant-warning manual) condition produced significantly higher compliance than the redundant-warning manual (only) condition ($p < 0{\cdot}05$).

Compliance to each of the three warning instructions was also analysed separately. The overall chi-square value for the 'Turn Off Computer' instruction was not significant. Analysis of the 'Ground the Plug' instruction showed a significant effect of conditions, χ^2 (6, $n = 84$) = 17·43, $p < 0{\cdot}01$. Subsequent chi-square comparisons showed that the basic manual produced significantly lower compliance than all conditions except the redundant-warning manual (only) condition and the redundant-warning manual plus cover-page supplement directive condition. In addition, the front-of-drive directive (plus redundant-warning manual) condition produced significantly higher compliance than the redundant-warning (only) condition. Analysis of the 'Eject Transport Disk' instruction showed a significant effect of conditions, χ^2 (6, $n = 84$) = 13·03, $p < 0{\cdot}05$. Subsequent comparisons showed that the basic manual produced significantly lower compliance than all of the other conditions except the redundant-warning manual (only) condition.

The items on the post-task questionnaire showed that 51% of the participants reported that they owned a microcomputer. Of the computer owners, 70% reported that they set up their computer themselves, 95% said that it was connected to accessory equipment, and 63% said that they first learned to use their computer without the help of another person. Seventy-six per cent reported that they owned a stereo. Of these owners, 71% reported that they set up their stereo themselves, 88% said that it was connected to accessory equipment, and 88% said that they first learned to use their stereo themselves. Lastly, 69% reported that they owned a VCR. Of these individuals, 62% reported that they set up the VCR themselves, 66% said that it was connected to accessory equipment, and 81% said that they first learned to use the VCR themselves.

Correlations were used to examine the relation between compliance and the responses to the previous-experience questionnaire items. Analysis showed that participants were less likely to comply with the warnings if they owned a microcomputer ($r = -0{\cdot}31$), first learned the computer by themselves ($r = -0{\cdot}30$), and set up their own stereo equipment ($r = -0{\cdot}28$) and VCR ($r = -0{\cdot}26$), $ps < 0{\cdot}05$.

A composite score for experience was derived by totalling the positive responses from all of the experience items. With these scores, a median-split was used to divide participants into two groups of approximately equal size (without cutting into tied scores) of less ($n = 40$) and more ($n = 44$) experience with electronic equipment. Table 2 shows the mean compliance scores as a function the experience variable and condition. A 7 (warning condition) × 2 (experience) analysis of variance showed significant main effects of warning condition, $F(6,70) = 2{\cdot}63, p < 0{\cdot}05$, and experience, $F(1,70) = 8{\cdot}83, p < 0{\cdot}01$. Participants with less experience ($M = 2{\cdot}52$) complied more than participants with more experience ($M = 1{\cdot}70$). Though there was no significant interaction, $F(6,70) < 1{\cdot}0$, $p > 0{\cdot}05$, planned simple effects analysis showed a significant effect of warning conditions for the highly experienced participants, $F(6,70) = 2{\cdot}38$, $p < 0{\cdot}05$, but no reliable effect of warning conditions for the less experienced participants, $F(6,70) = 1{\cdot}0, p > 0{\cdot}05$. Comparisons among the means using the LSD test showed that experienced users who received the basic manual. ($M = 0{\cdot}50$) compiled significantly less often than those receiving the redundant-warning manuals with the supplemental directive on the front of the manual ($M = 2{\cdot}0$), on the leaflet ($M = 2{\cdot}57$), on the drive cable ($M = 2{\cdot}00$), and on the front of the drive ($M = 2{\cdot}60$). Also,

Table 2. Mean compliance score as a function of participants' reported previous experience with electronic equipment.

Conditions	Low experience ($n = 40$)	High experience ($n = 44$)
(a) Basic manual	1·67	0·50
(b) Redundant-warning only	2·40	1·00
Redundant-warning manual plus the supplemental directive on the		
(c) Box	3·00	1·50
(d) Cover page	2·33	2·00
(e) Leaflet	2·40	2·57
(f) Drive cable	3·00	2·00
(g) Front drive	2·86	2·60
Mean	2·52	1·70

highly experienced participants having only the redundant-warning manual ($M = 1·00$) complied significantly less often than those receiving the same manual together with the leaflet and front-of-drive supplement directive.

4. Discussion

The results show that proximal placement of a supplemental directive to a product installation procedure increased compliance to warnings in an owner's manual. In particular, the supplemental directive placed on the front of the disk drive produced significantly higher compliance than the basic and redundant-warning (only) conditions. This result extends a finding reported by Wogalter *et al.* (1991) that suggested that people would be more likely to read a warning if it was located in close proximity to the product. It also confirms other related results showing the importance of location in other warning applications (Frantz and Rhoades 1993, Wogalter *et al.* 1987). However, the results do not support Strawbridge's (1986) failure to find an effect of warning location on a glue bottle label. One difference between the Strawbridge (1986) study and the other research is that the separate locations in the Strawbridge study were not as different from one another as the other studies' location conditions. Thus, Strawbridge's failure to find a difference in location might be attributable to their relative equality in terms of proximity.

The fact that most studies investigating warning location have found an effect using very different tasks gives some support to proximity's importance and generality. However, Strawbridge's (1986) null finding illustrates that there may be other important considerations with regard to proximity. One of these concerns the question: what is the warning proximal to? Proximity can be defined in a number of ways including physical distance and time. In the former, proximity can be quantified by measurement of the linear space between the warning and the product or user. In the latter, proximity can be defined in terms of the time that the warning appears while the user performs a task with the product. The task time view of proximity is likely to be a more effective warning method as it considers how people behave with the product. For example, it is possible that a label directly on a piece of equipment (highly proximal in terms of physical space to the equipment) might not be effective in situations where people tend to pay more attention to other (more physically distant) materials while performing a

task with the equipment. Thus, strategically placing the warning so that people see the warning when and where it is needed in the task is likely to be more effective than merely placing the warning directly on the product without considering how the people use the product. Systematic task analyses of people's behaviour with products along with quantification and scaling of proximity is needed to determine the factors that play a role in the effectiveness of different warning placements.

While location of the supplemental directive influenced compliance, the placement of warnings in the manual did not yield a significant effect (i.e., the redundant-warning manual versus the basic manual). However, the data show a consistent trend of higher compliance to the redundant-warning manual compared to the basic manual. Had more participants been included in this experiment, this factor might have shown a significant effect. Further investigation is necessary to determine whether the redundant-warning manual alone can increase compliance and whether the difference in compliance is of practical importance.

In general, less experienced users tended to comply more often with the warnings than the experienced users. This result supports previous questionnaire research (Godfrey *et al.* 1983, Wogalter *et al.* 1991, Wright *et al.* 1982) showing that self-reported inexperience to be associated with greater willingness to read warnings and instructions. Moreover, the results also show that the utility of the supplemental directive depends on the familiarity of users with similar equipment. While the less experienced users were not influenced by the presence and location of the supplemental directive, the more experienced users complied more often when it was placed at the more proximal locations to the equipment. Quite possibly, more experienced users' scripts did not include a 'consult the manual' action when setting up the equipment. The presence of a supplemental directive introduced an additional, unfamiliar feature into their established procedure that interrupted their script-driven processes, serving to gain their attention and motivating them to examine and comply with the warnings in the owner's manual. The less experienced users had scripts that were not as well developed. To a greater extent, they had to rely on the information made available during the installation task and, as a consequence, they did not need as much encouragement to motivate them to examine the materials.

Besides proximity, two other factors could have contributed to the high compliance rate of the front-in-drive condition. One is that in this condition the position of the directive required the most physical interaction to complete the installation task (i.e., the user had to remove the supplemental directive in order to eject the transport disk). Recent research by Duffy *et al.* (1993) and Frantz and Rhoades (1993) show that warning placements that act to interfere with task performances are more effective than those that do not. The results of these two studies as well as the current study suggest that warning interactivity may be a useful feature to help gain compliance from experienced users. However, other recent research makes the utility less clear. For example, Hunn and Dingus (1992) failed to find a significant effect of warning interactivity using a glass cleaner container with a warning label that put mild pressure on the hand while in use. Additional research is needed to delineate the circumstances under which interactivity facilitates compliance.

Another factor that could have benefited compliance in the front-of-drive condition is that it is unusual to find a label blocking use of the equipment. Not only would people be more likely to notice the directive in this position, but also its less-common placement might have created a belief by the more experienced participants that the manufacturer deemed the directive's message to be particularly important. This belief change might

then have positively affected the user's motivation to comply. However, beliefs were not measured in the current study. This issue requires further investigation.

These results have implications for equipment safety instructions and hazard warnings. The simple inclusion of warnings in an owner's manual will not necessarily lead to compliance, especially when users have experience with similar equipment. For experienced users, the safety directives and the warnings probably need to be particularly salient to get them to notice the information and to motivate them to change their behaviour. In addition, the results show that safety information accompanying consumer products can be designed to alert users of different levels of experience to potential hazards and to instruct them to perform precautionary behaviour. The supplemental directive may be useful in accommodating users who might not normally attend to warnings and instructions. In such cases, the directive should be placed at a location that interrupts experienced users' automated sequence of behaviours.

While not investigated in the current study, an indirect implication of this research is that manufacturers need to consider the fairly common situation in which the owner's manual is not available, such as when it is misplaced or when the equipment is purchased from previous owners or used-product dealers (Rhoades *et al.* 1991). In such cases, additional measures may be necessary such as affixing permanent labels directly on the equipment describing the most important safety information that also includes the manufacturer's mailing address and phone number so that owners can obtain technical assistance and a replacement copy of the manual.

Acknowledgements

We would like to thank Raheel Rashid for his assistance in carrying out this research. We also appreciated the helpful comments of Judy Edworthy and two anonymous reviewers. Portions of this research were presented in a poster session at the 36th Annual Meeting of the Human Factors Society (October 1992) in Atlanta, Georgia, USA.

References

DUFFY, R. R., KALSHER, M. J. and WOGALTER, M. S. 1993, The effectiveness of an interactive warning in a realistic product-use situation, *Proceedings of the Human Factors and Ergonomics Society 37th Annual Meeting* (Human Factors Society, Santa Monica, CA), in press.

FRANTZ, J. P. and RHOADES, T. P. 1993, A task analytic approach to the temporal and spatial placement of product warnings, *Human Factors*, **35**, 719–730.

GODFREY, S. S., ALLENDER, L., LAUGHERY, K. R. and SMITH, V. 1983, Warning messages: will the consumer bother to look?, *Proceedings of the Human Factors Society 27th Annual Meeting* (Human Factors Society, Santa Monica, CA), 950–954.

HUNN, B. P. and DINGUS, T. A. 1992, Interactivity, information and compliance cost in a consumer product warning scenario, *Accident Analysis and Prevention*, **24**, 497–505.

RHOADES, T. P., FRANTZ, J. P. and HOPP, K. M. 1991, Manufacturer's product information: Is it transferred to the second owner of a product? *Proceedings of Interface 91* (Human Factors Society, Santa Monica, CA), 94–99.

SCHANK, R. C. and ABELSON, R. 1977, *Scripts, Plans, Goals, and Understanding* (Lawrence Erlbaum, Hillsdale, NJ).

STRAWBRIDGE, J. A. 1986, The influence of position, highlighting, and imbedding on warning effectiveness, *Proceedings of the Human Factors Society 30th Annual Meeting* (Human Factors Society, Santa Monica, CA), 716–720.

WOGALTER, M. S. and YOUNG, S. L. 1991, Behavioural compliance to voice and print warnings, *Ergonomics*, **34**, 79–89.

WOGALTER, M. S., BRELSFORD, J. W., DESAULNIERS, D. R. and LAUGHERY, K. R. 1991, Consumer product warnings: the role of hazard perception, *Journal of Safety Research*, **22,** 7–82.

WOGALTER, M. S., GODFREY, S. S., FONTENELLE, G. A., DESAULNIERS, D. R., ROTHSTEIN, P. R. and LAUGHERY, K. R. 1987, Effectiveness of warnings, *Human Factors*. **29,** 599–612.

WRIGHT, P., CREIGHTON, P. and THRELFALL, S. M. 1982, Some factors determining when instructions will be read, *Ergonomics*, **25,** 225–227.

YOUNG, S. L. and WOGALTER, M. S. 1990, Comprehension and memory of instruction manual warnings: Conspicuous print and pictorial icons, *Human Factors*, **32,** 637–649.