GUIDELINES FOR WARNINGS DESIGN: DO THEY MATTER?

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ABSTRACT

A study was carried out using four measures of effectiveness to compare product warnings that are consistent with the American National Standards Institute Product Safety Signs and Labels standard (ANSI Z535.4) to warnings that are not consistent with the standard. Inconsistent warnings were based on the format of existing product warnings. Two warnings, consistent and inconsistent, for each of ten different products were evaluated: cooking oil, trampoline, paint, dresser, airbag, seat belt, tire, sports utility vehicle, reclining seat and swimming pool. The four effectiveness criteria were judgments of noticeability, likelihood to read, understandability and likelihood of complying. Participants were 176 students with varied majors from five different universities. Results indicated higher levels of judged effectiveness for the warnings that were consistent with the ANSI standard. The differences were statistically significant for all four effectiveness measures for all ten products. While warnings that are consistent with the ANSI Z535.4 standard do not by themselves necessarily constitute an adequate warning system, these results indicate that the standard does have merit and utility and represents a good starting point in warning design.

INTRODUCTION

Recent years have witnessed a substantial amount of research on the topic of warnings. This research has focused on both design and effectiveness issues. Several books and articles have appeared that summarize and review the published work in this field (e.g., Edworthy and Adams, 1996; Laughery and Wogalter, 1997; Parsons, Seminara and Wogalter, 1999; Rogers, Lamson and Rousseau, 2000; Wogalter, DeJoy and Laughery, 1999; Wogalter and Laughery, 1996; Wogalter, Young and Laughery, 2001; and Miller and Lehto, 2002. During this same period, various guidelines and standards have also appeared. A noteworthy example is the American National Standards Institute Product Safety Signs and Labels (ANSI Z535.4) standard (1991, 1998) for product warnings. Other similar standards are the ANSI Z129.1 (1994) for chemical products and the T5 guideline for safety signs and labels published by the American Boat and Yacht Council, Inc. (1996).

Generally, the guidelines are consistent with the findings of the published research. The focus of the guidelines, such as ANSI Z535.4, is on two categories of warning design factors; namely, format and content. Format issues concern such factors as arrangement of the different warning components, use of color, size of print, and so forth. Content issues include the kinds of information to be presented (signal word, hazard, consequences and instructions) and the use of pictorials.

A central question associated with the guidelines for warning design is whether the characteristics of warnings as recommended by the guidelines make a difference; that is, are the warnings that follow the recommendations more likely to be effective than warnings that do not. The research on warning effectiveness (Wogalter, Kalsher, Frederick, Magurno, & Brewster, 1998) would indicate that the answer is "yes," but generally the studies reported in the research literature examine the effects of one or two design parameters on effectiveness. The purpose of the research reported in this article is to examine the judged effectiveness issue by comparing warnings that are not consistent with the ANSI Z535.4 standard with warnings that are consistent with the standard. It should be noted that the issue here is not adequacy. This study is not intended to determine if a warning consistent with the standard constitutes an adequate warning system. Additional considerations, such as other warning components in the system would be a part of such evaluations. The issue here is whether warnings consistent with the standard are judged better than those that are not.

METHOD

Materials

Ten pairs of product warnings were developed. The specific products and related safety issues (in parentheses) were:

- Cooking oil (fire)
- Seat belts (lap belt use)
- Trampoline (summersaults)
- Tires (belt separation)
- Paint (vapors)
- Sports Utility Vehicles (stability)
- Dresser (stability)
- Seat recline (vehicle restraint)
- Airbag (deployment)
- Swimming pool (diving)

Seven of the 10 warning pairs are shown in Figures 1-7. Space does not permit the seat belt, diving and SUV warnings to be included. For each pair, one of the warnings (warning A in the figure) was *actually* used on the product, and based on criteria described below was judged to be inconsistent with the ANSI Z535.4 standard. The second warning of the pair (warning B in the figure) was developed or selected on the basis of the criteria to be consistent with the standard.

The criteria for deciding whether or not a warning was consistent with the ANSI Z535.4 standard included:

- The use of a standard signal word (caution, warning or danger);
- The use of appropriate color based on the choice of signal word;
- The presence of a pictorial;
- Information regarding the hazard(s);
- Information regarding the consequences;
- Instructional information for safe use.

All but one of the ANSI consistent warnings contained color; in Figure 1 the shaded areas were in color. The background for the warnings containing the signal words CAUTION, WARNING and DANGER were yellow, orange and red respectively. An exception to this combination was the airbag warning where the signal word WARNING had a yellow background. Where a negation sign (circle-slash) appeared, it was red. An exception to the use of color was the tire failure warning that would appear in black as a raised image on the sidewall of a tire.

Generally, a warning had to meet all of the above criteria to be considered ANSI compliant. It should be noted that the seat back recline warning was placed in the inconsistent category although it meets the above criteria. It was included here for a somewhat different reason; namely, it appeared only in the vehicle manual and not on the product. We included it because survey research (Mehlenbacher, Wogalter & Laughery, 2002) has shown most people do not read or do not completely read vehicle manuals. Thus, the comparison of the two seat back recline warnings addresses a warning location issue; on the product versus in the manual.

Participants

The participants in the study were 207 students enrolled at five different universities: The University of Houston, Rice University, North Carolina State University, Rensselaer Polytechnic Institute and the University of Georgia. Each participant saw from four to six of the warning pairs, and different participants saw different combinations of the warnings.

Table 1. Means of Effectiveness Ratings for Warnings that are Consistent (C) and Inconsistent (IC) with the ANSI Z535.4 Standard.

		Effectiveness Ratings							
		Notice		Read		Understand		Comply	
Product	N	IC	C	IC	C	IC	C	IC	C
Dresser	106	57	86	43	75	45	77	37	63
Airbag	107	67	85	53	74	39	76	42	72
Diving	107	79	89	78	84	46	84	56	79
Cooking Oil	107	46	80	32	66	38	67	33	65
Paint Vapors	107	47	87	33	71	39	70	37	66
Trampoline	105	51	84	32	69	31	77	26	57
Seatbelt	207	50	83	33	64	26	69	35	64
SUV Rollover	146	54	86	33	75	42	61	33	57
Tire Failure	181	45	72	31	55	26	68	18	43
Seat Reclined	154	21	84	21	70	35	71	19	46

Procedure

The participants were run in groups that varied in size from 1 to 10. When they arrived in the laboratory, each participant was given a booklet containing several pages. The first page contained general instructions. For each warning pair evaluated by the participant, there were two pages in the booklet. The first page of the pair contained specific instructions for that particular warning pair and four questions regarding each of the two warnings. The four questions asked the participant to rate the two warnings on likelihood to notice, read, understand and comply. The instructions for all ten warning pairs asked the participant to rate the warnings by estimating how many of 100 people using the product and exposed to the warning would notice, read, understand and comply. The second page for that warning pair contained the two warnings. The warnings, of course, were larger than shown in the figure. Also, the ANSI compliant warnings appeared equally often (half the time) at the top and bottom of the sheets. The last page of the booklet asked for some demographic information; gender, age and ethnicity. Responses to the demographic questions were voluntary.

RESULTS

Table 1 presents the means of the ratings for each of the warnings on each of the four dimensions. The values represent the numbers out of one hundred product users who participants believed would read, notice, understand and comply with the warnings. In part, this scale was used because it makes it possible/convenient to think of the numbers as percentages. The ratings were compared using *t*-tests on the 40 pairs shown in the table. Differences between all pairs were statistically significant. The significance of the notice ratings difference for the diving warnings (means 79 and 89) was $p < .002$, and the significance of the read ratings for the diving (means 78 and 84) was $p < .04$. All other pairs differed significantly at $p < .001$.

DISCUSSION

The results are quite clearcut. In terms of the rating procedures employed, the warnings designed or selected to be consistent with the ANSI Z535.4 standard were judged to be superior to the warnings inconsistent with the standard. Indeed, on all four of the dimensions evaluated (notice, read, understand and comply), the ANSI consistent warnings were given higher ratings.

It is noted that the evaluations of the warnings in this study are based on ratings as opposed to behavioral observations. We do not suggest that the ratings reflect actual values of noticing, reading, understanding and complying to the warnings. It has long been recognized that such ratings are subject to various types of biases depending on the circumstances. We do, however, make two points. First, to the extent that the compliance estimates reflect behavioral intentions, the higher rated warnings can be expected to lead to greater levels of compliance. A meta-analysis by Kim and Hunter (1993) showed a high correlation between behavioral intentions and behavior, $r = 0.82$. The second point is that the primary purpose of this study was to assess the utility of the ANSI Z535.4 standard. Thus, the critical question is how well do the warnings that are inconsistent with the standard compare to the warnings that are consistent. The results clearly indicate that the standard has merit and utility in promoting product safety. As noted earlier, these results are not a basis for concluding that a warning consistent with the ANSI standard constitutes an adequate warning system. There is more to be considered in designing a warning system, such as other components of the system (manuals, verbal warnings, etc.), characteristics of the target audience, and cost of compliance. Warning system design may also include consumer evaluations to verify effectiveness. The ANSI standard represents a good starting point.

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A

CAUTION: ANY OIL WILL BURN IF OVERHEATED. DO NOT LEAVE UNATTENDED WHILE HEATING. IF SMOKING OCCURS, REDUCE HEAT. IF OIL CATCHES FIRE, TURN OFF HEAT AND COVER POT UNTIL COOLED. DO NOT PUT WATER ON HOT OR FLAMING OIL! DO NOT POUR HOT OIL BACK INTO THIS PLASTIC CONTAINER.

B

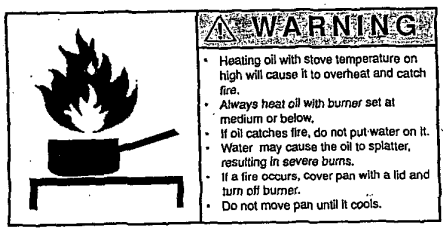


Figure 1. Cooking Oil

A

CAUTION TO AVOID SERIOUS INJURY

- For maximum safety protection in all types of crashes, you must always wear your safety belt.
- Do not install rearward-facing child seats in any front passenger seat position.
- Do not sit or lean unnecessarily close to the air bag.
- Do not place any objects over the air bag or between the air bag and yourself.

See the Owner Manual for further information and explanations.

B

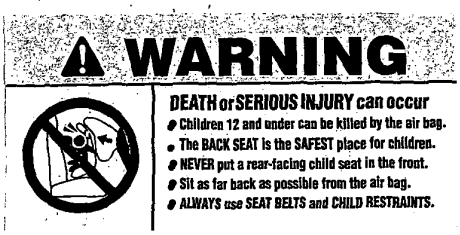


Figure 2. Airbag

A

CONTAINS PETROLEUM DISTILLATE

Keep away from heat and flame. To avoid breathing vapors or spray mist, open windows and doors or use other means to ensure fresh air entry during application and drying. If you experience eye watering, headaches or dizziness, increase fresh air or wear respiratory protection (NIOSH/MSHA TC 23C or equivalent) or leave the area. Close container after each use. Avoid contact with skin.

NOTICE: Reports have associated repeated and prolonged occupational over-exposure to solvents with permanent brain and nervous system damage. Intentional misuse by deliberately concentrating and inhaling the contents may be harmful or fatal.

B

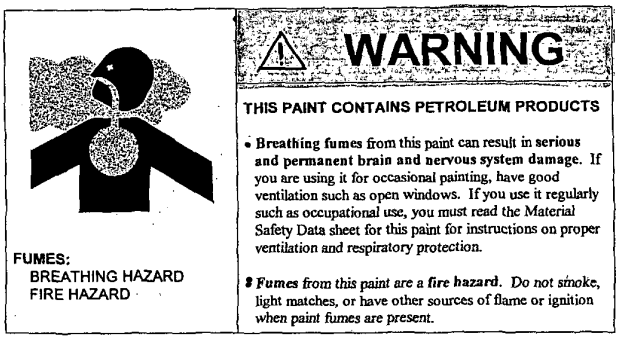


Figure 3. Paint Vapors

A

CAUTION

Misuse and abuse of this trampoline is dangerous and can cause serious injuries. Read instructions before using this trampoline. Inspect before using and replace any worn, defective or missing parts. Any activity involving motion or heights creates the possibility of accidental injuries. This unit is intended for use only by properly trained and qualified participants under supervised conditions. Use without proper supervision could be dangerous and should not be undertaken or permitted

B

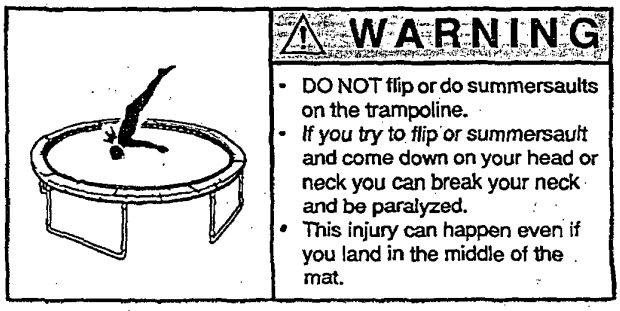


Figure 4. Trampoline

A

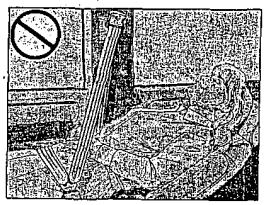
warning warning warning

Please do not allow your child to use this product as a climbing device or recreational toy. The chest or dresser drawers may tip over onto the child if too much weight is applied to the drawers. The drawer cannot be removed unless a strong pull or jerk is applied. However, if the drawer is removed, a strong push inward would return it to a working position. Failure to follow this warning could result in serious injury.

B

Figure 5. Dresser

A



But don't have a seatback reclined if your vehicle is moving.

⚠ CAUTION:

Sitting in a reclined position when your vehicle is in motion can be dangerous. Even if you buckle up, your safety belts can't do their job when you're reclined like this.

The shoulder belt can't do its job because it won't be against your body. Instead, it will be in front of you. In a crash you could go into it, receiving neck or other injuries.

The lap belt can't do its job either. In a crash the belt could go up over your abdomen. The belt forces would be there, not at your pelvic bones. This could cause serious internal injuries.

For proper protection when the vehicle is in motion, have the seatback upright. Then sit well back in the seat and wear your safety belt properly.

B

⚠ WARNING

SEAT BACK UP! WHEN VEHICLE IS MOVING

If seatback is reclined in an accident, you can slide under the belts and be **ejected** or:

- **catch your neck** on the shoulder belt and break it
- suffer severe or **fatal internal injuries**

Be sure shoulder belt is against your shoulder.

Figure 6. Seat Recline

A

SAFETY WARNING: • TIRE FAILURE DUE TO UNDER INFLATION/OVERLOADING – FOLLOW OWNER'S MANUAL OR TIRE PLACKARD IN VEHICLE

SERIOUS INJURY MAY RESULT FROM: • EXPLOSION OF TIRE/RIM ASSEMBLY DUE TO IMPROPER MOUNTING – NEVER EXCEED 40 PSI TO SEAT BEADS – MOUNT ONLY ON 15 INCH DIAMETER RIMS – ONLY SPECIALLY TRAINED PERSONS SHOULD MOUNT TIRES

B

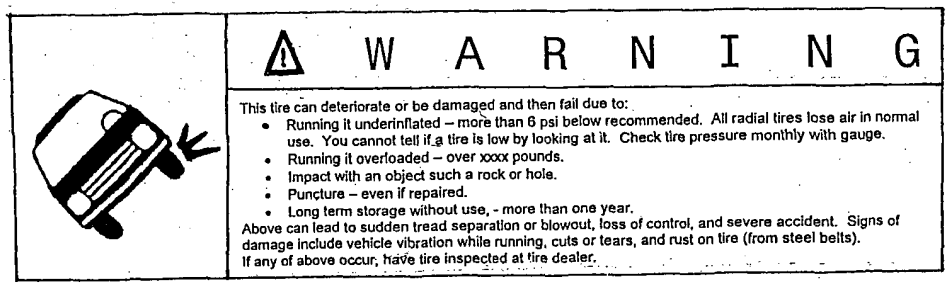


Figure 7. Tire Failure