IMPROVING SWIMMING POOL WARNING SIGNS

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ABSTRACT

The U.S. Consumer Product Safety Commission sponsored us to perform a human factors evaluation of existing swimming pool warning signs. Our study covered warnings which convey the messages "NO DIVING" and "WATCH CHILDREN". These warnings are particularly intended to reduce the incidence of diving accidents involving teenage boys and drowning accidents involving children under five; population groups that are over-represented in accident statistics. Our evaluation of twenty-two existing signs uncovered deviations from warning sign design principles and identified opportunities to improve each of the signs. Following the evaluation, we developed improved signs and tested them using teenage boys and mothers of young children as subjects. We then made final recommendations to the CPSC for improved signs.

INTRODUCTION

Accident statistics collected by the U.S. Consumer Product Safety Commission (CPSC) show that teenage boys and children under five are at highest risk, compared to other population segments, of being injured or killed in swimming pools. Drowning is one of the leading causes of death for children under five, because they are not accomplished swimmers and can escape adult supervision. Teenage boys are most likely to have diving accidents resulting in head or neck injury because they may not perceive the risks and consequences of diving into shallow water, may use pools while intoxicated, and are prone to be risk-takers.

To mitigate these problems, numerous warning signs for pools have been developed by the swimming pool industry and by safety groups. The signs vary widely in format, message content, and use of pictorials (illustrations). The majority of the signs could be improved through the application of human factors research and warning sign design principles.

The CPSC wanted to evaluate existing swimming pool warning signs and develop recommendations for signs that people would likely post, voluntarily, at their own pools. In response, we designed new signs based on human factors principles, design criteria provided in ANSI standards, and subject testing. In the process, we recognized the debate over whether warning signs will actually reduce accidents (McCarthy, et al., 1984). Yet, we felt that the signs that are posted should be optimally designed and sufficiently tested.

PROBLEMS WITH EXISTING POOL WARNING SIGNS

We collected existing pool warning signs from the CPSC, safety groups, independent consultants, and the pool industry. Although it appeared that considerable effort was applied to develop good signs, each of the twenty-two that we examined was found to have one or more design deficiencies.

Many signs incorporated messages that were too long. Several had multiple paragraphs of instructions. We considered it unlikely that people would take the time to read such long messages. Also, some of the signs had poor sentence structure or messages that were too complicated, with vocabulary aimed at an audience with an advanced education level. For example, one sign said "Never trust flotation devices. Inflatable water toys can deflate." The complexity of the words "flotation" and "deflate" was a problem because the reading levels of pool users can be low.

Several signs had messages written in character fonts that were difficult to read, and some used all uppercase letters and centered lines of text. Human factors research has determined that the text style that is best for rapid, continuous reading is left-justified with a ragged right margin, using mixed upper and lowercase characters (Tinker, 1963). We also found that some of the pictorials

included on the existing pool signs were not easily recognized or could be misinterpreted.

Finally, some of the existing signs omitted one of the three key elements for good warning signs specified in the American National Standard ANSI Z535.2-Draft-1987: signal word, text message, and pictorial. While pictorials are not deemed mandatory by the standard, their use is recommended because pictorials communicate to people who do not read English or who are illiterate (FMC Corp., 1985; Westinghouse, 1981; Fasbinder, 1987).

WHAT MAKES A GOOD WARNING SIGN?

We reviewed warning sign design literature covering diverse applications including traffic safety, industrial safety and consumer product safety. Seeking to create a coherent compilation of design recommendations, we assessed the applicability of a variety of recommendations to swimming pool warning signs and created a final checklist for our evaluations and subsequent redesign efforts.

We determined that a good swimming pool warning sign should have (1) a signal word such as DANGER, WARNING, or CAUTION, (2) a text message, and (3) a pictorial. The format, or overall layout, of the sign should follow one of the formats given in ANSI Z535.2-Draft-1987. The signal word should be chosen using the criteria in that standard as well. The text message should describe the hazard, its consequences, and tell the reader how to avoid the hazard. The message should be worded simply so that people with a low reading level can understand it. The sentences should be short and concise, with no unnecessary information. The lettering style should be large and bold enough to be read from the expected viewing distance. References such as the Human Factors Design Handbook (Woodson, 1982) are an appropriate source of guidelines for character heights at varying distances. The lettering should be left justified with a ragged right margin, in a sans serif style.

If a pictorial is included, it should be large enough to convey its meaning at the expected viewing distance. It should be simple, without unnecessary details that could confuse or add visual clutter. It should not be so abstract that the viewer needs to study it at length in order to understand it.

HOW WE DEVELOPED OUR IMPROVED SIGN CANDIDATES

Since we found at least minor deficiencies in all of the existing warning signs we examined, we were left with the task of developing more effective ones. This task was complicated by the fact that the signal word, text message, and pictorial elements of a warning sign are interrelated, working together to convey a complete warning. Our goal was to develop the best integrated warning sign, as opposed to just optimizing each of the elements. We knew, for instance, that a pictorial judged best on a stand-alone basis might not produce the best warning when combined with a text message. However, we chose first to determine the most promising options for the three discrete elements of the warning signs, and then test them in combination.

To determine the most promising elements, we conducted an in-house evaluation. Twenty-two adults were asked to rank order alternative messages and pictorials for "NO DIVING" and "WATCH CHILDREN" signs. The alternatives were selected based on the results of our critique of the existing signs and our judgment. For the text message alternatives, we added new options to the most promising existing messages to provide a wider range of phrasings. For the pictorials, we added one "NO DIVING" option created by following the FMC guidelines (FMC Corp., 1985), and we added several original "WATCH CHILDREN" options.

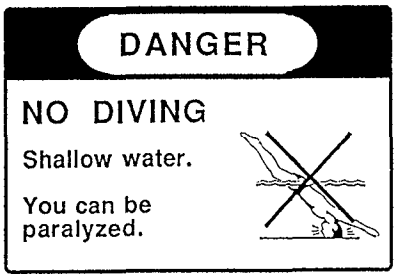
From the results of the effectiveness survey, we settled on a set of preferred warning sign elements that could be combined to form complete warning sign candidates. The signal word "DANGER" was treated as a constant based on the scenarios in question and our understanding of the hazard level as described in the ANSI standard.

Figures 1 and 2 show alternative warning signs for the categories "NO DIVING" and "WATCH CHILDREN." When we prepared complete warning signs from the best alternative elements, we used the horizontal format prescribed by ANSI Z535.2-Draft-1987. We used a Helvetica Bold font because it was plain and maximized readability from a distance. The signs included black text on a white

background, except for the signal word, which used white letters on a red background.

HOW WE DECIDED ON OUR FINAL RECOMMENDATIONS

Instead of deciding for ourselves which messages and pictorials worked best together, we conducted a small-scale test. We produced a set of alternative warning sign designs with varied combinations of texts and pictorials. When the warning sign design effort was complete, we prepared mockups of each sign.



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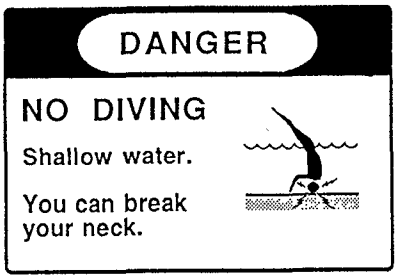

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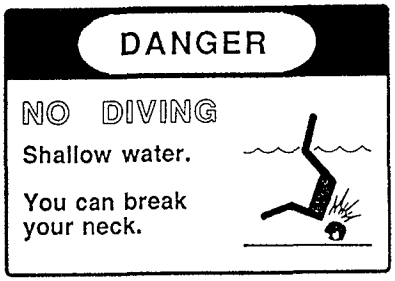

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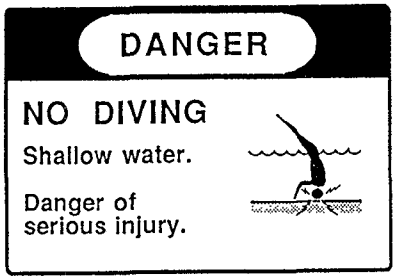

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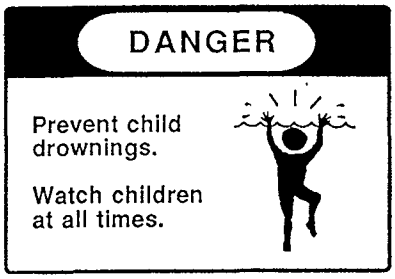
Figure 1: Alternative NO DIVING Signs



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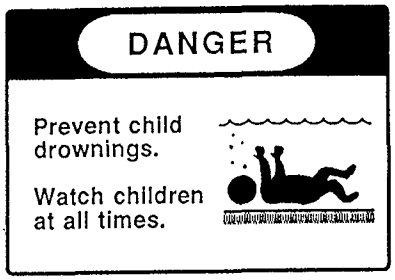

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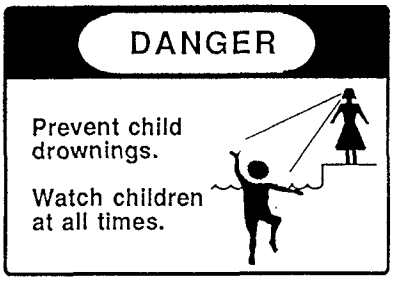

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Figure 2: Alternative WATCH CHILDREN Signs

Our test had to be limited to nine subjects, a requirement for federally sponsored surveys conducted without Office of Management and Budget clearance. Because accident statistics indicated that teenage boys were the high risk group for diving accidents and children under five years of age were the high risk group for drowning accidents, our sample included five teenage boys who participated in swimming programs, and four mothers of young children. Although the teenage boys were the principal target of the "NO DIVING" signs and the mothers were the principal target of the "WATCH CHILDREN" signs, each group provided feedback on all of the signs.

The subjects preferred the messages "You can be paralyzed" and "You can break your neck" to "Danger of serious injury." One teenager said, "'Serious injury' is just no big deal. I wouldn't listen to that." The teenage boys told us that the signs with the most "gruesome" pictorials would be most effective to them. One subject

cautioned us that teenage boys would look at the pictorial and possibly read the words "NO DIVING," but would not take the time to read any more of the message. Although the subjects generally preferred the pictorial that was the most human looking (A in Figure 1), they could not see it very well from a distance, reportedly because it was an outlined rather than solid figure.

The mothers of young children were disturbed by the "WATCH CHILDREN" pictorials. One brought her hands to her face and said, "I hate it! This is awful!" The subjects overall preferred the pictorial that showed a struggling child, rather than one at the bottom of the pool, because the child was still alive. The mothers pointed out that they would not post a sign with an excessively morbid pictorial.

Although our subjects had varying preferences among the alternative warning sign elements, we were able to identify the preferred warning sign designs.

OUR IMPROVED "NO DIVING" SIGNS

We committed to the text message "NO DIVING" after the effectiveness study because it was shorter and was considered more effective than the message "DO NOT DIVE." The message is written in all capital letters to highlight it as the most important part of the total text. We tested the effectiveness of writing "NO DIVING" in red during our pilot test. Although some people felt that the red color drew greater attention to the message, most people did not feel the color coding was necessary. Though either alternative would fit ANSI guidelines, we concluded that black lettering would be slightly more legible when read from a distance or in low lighting conditions and would not detract from the visibility of the signal word. We added an exclamation point after the phrase "NO DIVING" because a large number of people in the effectiveness survey and pilot test suggested it would add emphasis.

The messages "You can break your neck" and "You can be paralyzed" were considered most effective among the alternative phrasings. Mothers generally preferred "You can break your neck" because they felt that the word "paralyzed" might not be understood by younger children due to their limited vocabulary. The teenagers thought that the phrasing "You can be paralyzed" was best because it was dramatic, threatening and attention-getting. We believe that both phrasings could be effective. However, since some people might not understand the word "paralyzed" while virtually everybody would understand the threat "You can break your neck," we recommended the latter. Another alternative phrasing, "Danger of serious injury," was considered too vague by both subject groups.

The alternative pictorials varied in terms of their level of human likeness and the symbol used to indicate an impact or injury. Subjects generally preferred the more human looking symbol shown in A of Figure 1, while they liked the visibility of the silhouetted human likenesses shown in B, C, and D. The less human-looking symbols were described as "fish" and "folding chairs." This feedback suggested that we use a realistic human silhouette.

Subjects felt that it was best to show the human in a distressed condition, rather than a healthy condition (though surrounded by impact symbols). The dislocated head shown in C of Figure 1 was considered effective for this reason. Both of the impact/injury symbols shown in B and C of Figure 1 were considered effective, leaving no doubt that the person's neck had been seriously injured. The straight lines emanating from the head in sign A suggested to the subjects that the person might only end up with a headache.

As a result of these findings, we determined that a hybrid of the alternative pictorials was needed and we developed the pictorial shown in Figure 3. This figure also shows the other features we recommended for an improved "NO DIVING" sign.

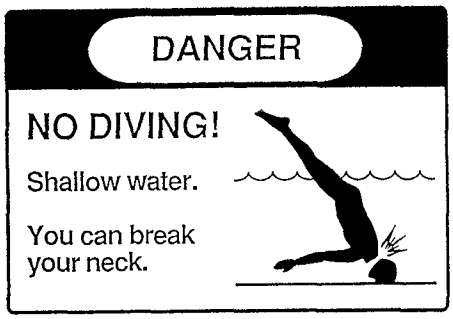

Figure 3: Recommended NO DIVING Sign

OUR IMPROVED "WATCH CHILDREN" SIGNS

Based on the results of our earlier effectiveness study, we concluded that the text message "Prevent child drownings. Watch children at all times." was optimal. There was nearly complete agreement among subjects that the pictorial showing a struggling child was best because it indicated a child in distress, and was not excessively morbid. The pictorial showing a child at the bottom of the pool was considered too harsh for the residential environment and was criticized because it showed death, as opposed to distress. The pictorial that included a mother (C in Figure 2) was understood by subjects to illustrate the precise message; a positive scene showing an adult watching a child playing in the water. However, the subjects thought the two threatening pictorials were more effective.

Our final recommendation was complicated by the fact that most people felt that they or their parents would not post a sign showing a drowning child; that they would be more inclined to post the more positive sign. Therefore, we recommended that the warning sign designs shown in Figures 4 and 5 be considered for implementation and that the CPSC collect more information regarding the likelihood that either sign would be posted by consumers.

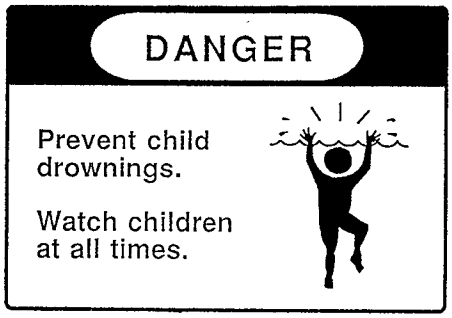

Figure 4: Recommended WATCH CHILDREN Sign (Alternative 1)

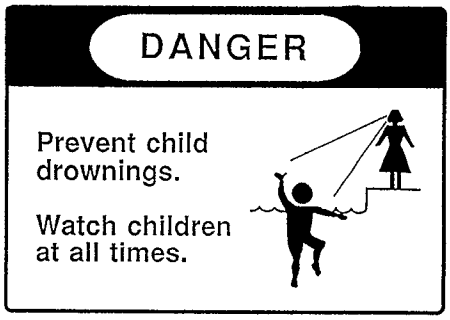

Figure 5: Recommended WATCH CHILDREN Sign (Alternative 2)

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