Pictorial Negations: Preferences for Different Circle-Slash Variations

Barbara L. Glover, Amy B. Magurno
La Tondra A. Murray, and Michael S. Wogalter
North Carolina State University
Raleigh, NC 27695-7801

ABSTRACT

A circle with a 45-degree slash overlayed on a pictorial has been increasingly used to depict a negation. However, in some cases this overlay could obscure critical parts of the symbol making the depiction difficult to recognize. The present study investigated whether participants would judge the acceptability of various kinds of circle-slash negation differently. Sixteen pictorials in both left-facing and right-facing orientations were combined with four versions of the red circle and slash: a conventional slash over the symbol, a slash under the symbol, a translucent slash, and a partial slash. Sixty participants rank ordered the combinations. The results generally indicated that the over and under versions were preferred to the translucent or partial slashes, an effect probably attributable to familiarity and Gestalt principles of good figures. Some symbols were differentially affected by orientation and slash type. The over slash versions were given lower evaluations when critical features were obscured. The results have implications for the development of symbols with the circle-slash negation for improved identifiability.

INTRODUCTION

The use of pictorials in warning signs and labels has become more prevalent in recent years due to product and equipment sales in the ever-widening global economy and the increased attention to multiculturalism. One reason for the interest in pictorials is their potential to convey messages when individuals are not able to read the language message of a warning.

Pictorials have been used to communicate both positive and negative messages. Pictorials with positive messages provide information about permitted practices or encouraged behavior. Pictorials with negative messages frequently convey information about actions that should not be taken in specific environments or situations, or about conditions to be prevented or avoided. Sometimes the negative message can be conveyed directly by a pictorial, such as the depiction of a person falling on a slippery floor. However, in some instances the message cannot be depicted directly, and one must provide a negation to a depicted behavior or condition. A common way to do this is to add a red circle surround and a red slash across the pictorial.

Initially implemented in Europe, the red circle and slash has been adopted in the United States and other countries to represent prohibition, and is recommended by ANSI Z535.2 (1991) and ISO 3864 (1984) standards documents on warning pictorial design. However, there has been little research on pictorial negation.

The motivation for the present research derives from earlier research conducted on the design of prohibitive traffic signs. Work by Gough (1965) suggested that traffic images depicted in a positive manner might be more easily understood than the same concept depicted in a negative manner. Dewar (1976) measured the glance legibility (comprehension after very brief viewing) of traffic sign pictorials. This is is an ecologically valid task because sometimes driving conditions permit only a brief period of time to comprehend a roadway sign before having to make a decision and possibly react. Dewar (1976) examined four prohibition variations: a red ring with a slash over the symbol, a red ring with a slash under the symbol, a red ring and partial slash, and a red ring with no slash. Participants were shown road-sign images for either 8 or 100 ms, and after each asked to match the visual image with a picture on an answer sheet. Dewar found greater accuracy with no slash or a partial slash than for the other two slash variants. Dewar concluded that the conventional negative circle-slash performed poorly because it increases sign complexity and frequently obscured portions of the pictorial.

The intent of the present study was to re-examine some of the slash variations used by Dewar as well as a new variation, the translucent slash. Perceived effectiveness in the form of preference ranks were measured. Examined was whether the conventional method of placing the slash over the pictorial negatively affects people's evaluations, particularly when it obscures underlying critical features. Another factor considered is pictorial orientation. For some pictorials, less detail is concealed by the slash if they are oriented in a right to left orientation instead of a left to right orientation or vice versa. Therefore, the degree of obscuration varied as a function of pictorial, slash type, and pictorial orientation.

We expected that participants would least prefer the over slash in general because it would more likely conceal more parts of the pictorial compared to the three other slash versions. However, because the over slash is the conventional method of depicting negation it might be the most preferred due to familiarity or because of its solid Gestalt configuration (Sanders and McCormick, 1993). Of the three alternative slash versions, we expected that: (a) the under slash would receive low evaluations because of reduced contrast due to its contiguous positioning relative to the pictorial and because much of the slash would be concealed; (b) the partial slash would also receive low evaluations because this version had the least surface area and because it might be perceived as an incomplete form; and (c) the translucent slash would be most preferred because the symbol is least obscured allowing the viewer to see the pictorial through the slash. However, the effects of the slash types might also depend on the pictorial and its orientation with respect to the slash.

METHOD

Participants

Sixty volunteers in the Raleigh, NC area participated. Thirty were students from introductory psychology courses at North Carolina State University who participated for research credit. Of these, 25 were male and 5 were female, having ages ranging from 18 to 26 (M = 19.5, SD = 1.8). Thirty additional participants were attendees at a local flea market, ranging in age from 21 to 65 (M = 38.9, SD = 13.2). The flea market participants were comprised of 14 males and 16 females, and were given a small gift (e.g., a mug, pen/pencil set, or cap) in exchange of their participation.

Materials

Sixteen pictorial concepts were used. They are shown in Figure 1 (in the over slash condition). Sets of cards (12.7 cm x 12.7 cm) were created, with each set displaying each pictorial in the four circle-slash types in two orientations for a total of eight cards per set. An example pictorial in its eight variations is shown in Figure 2. Each pictorial was laminated on individual cards. All pictorials were fully contained within a red circle and have an outside diameter of 11.3 cm and slash diameter of 1 cm. Pictorials were printed in black ink on a white background, with the circle and slash printed in safety red. As recommended in the ISO 3864 (1984) standard, the area of red included in the pictorial was 35% of the total area inside the outer rim of the circle, leaving 65% of the area for the symbol. In accordance with ANSI Z535.2 and ISO 3864 (1984), the slash was maintained in a fixed position at a 45 degree diagonal from the top left to the bottom right aspect of the circle.

Four slash conditions were tested: slash over (in front of) the pictorial, slash under (behind) the pictorial, a translucent slash, and a partial (broken) slash. In the over slash condition, the slash is opaque where it crosses over the pictorial. In the under slash condition, the pictorial is displayed uninterrupted (opaque) in front of the slash. In the translucent slash condition, the red slash changes color to gray (interacts) where it crosses the image showing the outline shape of the pictorial within that section of the slash. In the partial slash condition, the slash is displayed as short, truncated "stubs" that terminate before crossing the pictorial, leaving a small amount of white space between the stub and the pictorial. Pictorials were grouped by their approximate direction of orientation. Orientation I generally included objects facing or turned to the left. Orientation II had objects faced the opposite way. The criteria used to determine orientation were: (a) likely directional movement of the depicted object(s) and (b) relative weights (amount of ink and physical mass) of objects on the left and right sides of the pictorial.

Figure 1. The 16 pictorials in the Over Circle Slash.

Procedure

Participants were told that the study was investigating people's judgments of pictures. They were told that they should consider in their evaluations that the pictures might be viewed under poor environmental conditions such as in fog,

Figure 2. Example Pictorial in the 8 Variations of Slash Type (Over, Under, Partial and Translucent) and Orientation (Left-I and Right-II).

in rain, or at night. They were also told that some people, because of poor vision or having origins from different cultures, may have trouble seeing or understanding details. Participants were given the cards in sets consisting of the eight versions of the same pictorial concept, and asked to lay them out on the table in an order based on how effective they would be at conveying the message. Each participant ordered the cards from worst to best in a left to right direction. After the participant finished each set, the experimenter removed the cards and recorded the order. This procedure was continued until all 16 sets were ranked. The cards in each set were randomized before every presentation.

RESULTS

The data are ranks, thus, lower scores indicate greater preference. A 16 (pictorial) X 2 (orientation: I vs. II) X 4 (slash type: over, under, translucent, or partial) repeated-measures analysis of variance (ANOVA) was applied to these data. There was no main effect for pictorial, $F(15, 885) = 0.00$, $p = 1.0$, because all sets contained the same number of conditions to be ranked, i.e., the total scores and means always produced the same value (36 and 4.5, respectively). The ANOVA showed a significant main effect of orientation, $F(1, 59) = 9.39$, ($p < .01$). In general, left facing versions of the pictorials were preferred ($M = 4.43$) over right-facing ones ($M = 4.57$).

Also the ANOVA showed a significant pictorial X orientation interaction, $F(15, 885) = 10.12$, ($p < .0001$). Eight pictorials produced significant orientation differences ($p < .05$). Table 1 shows the means and the preferred orientation of these pictorials.

The ANOVA showed a significant main effect for slash type, $F(3, 177) = 101.68$, $p < .0001$. Comparisons among the means using the Tukey's Honestly Significant Difference (HSD) test showed that the over ($M = 3.02$) and under ($M = 3.46$) slashes did not significantly differ, but both were preferred compared to the translucent ($M = 4.72$) and partial ($M = 6.79$) slashes (ps $< .05$). The translucent slash was significantly preferred compared to the partial slash ($p < .05$).

There was a significant pictorial X slash type interaction, $F(45, 2655) = 6.51$, $p < .0001$. The partial slash was consistently the least preferred slash type across all pictorials. The translucent slash was consistently preferred compared to

Table 1. Means of Significant Orientation Differences.

		Orientation	
Pictorial	*Preferred*	*Left (I)*	*Right (II)*
No Flame	I	4.08	4.93
Don't Drink the Water	I	4.22	4.78
No Smoking, Eating, or Drinking	II	4.76	4.24
No Dogs	II	4.83	4.18
No Digging	I	4.11	4.89
No Diving	I	4.19	4.81
Do Not Climb Tower	I	4.39	4.61
Keep Out, High Voltage	II	4.28	4.72

the partial slash and consistently less preferred compared to the over and under slashes. However, there were two exceptions. Tukey's HSD test showed no significant difference between: (a) the translucent and under slash for the NO EXIT pictorial and (b) the translucent and the over slash for the KEEP OUT - HIGH VOLTAGE pictorial.

Additional comparisons using the Tukey's HSD test showed that the over slash was significantly preferred to the under slash for the following six pictorials ($ps < .05$): NO TURN (M = 2.52 vs. 3.61), NO FLAMES (M = 2.70 vs. 3.68), NO TRUCKS (M = 2.18 vs. 3.83), NO DOGS (M = 2.52 vs. 3.75), NO EXIT (M = 2.38 vs. 4.50), and DO NOT TOUCH SWITCH (M = 2.75 vs. 3.53). The under slash was significantly preferred compared to the over slash for two pictorials ($ps < .05$): DO NOT TOUCH EXPOSED GEARS (M = 3.00 vs. 3.98), and KEEP OUT - HIGH VOLTAGE (M = 3.04 vs. 4.11). No other pictorials showed a significant difference between the over and under slashes.

Finally, there was also a significant three-way pictorial X orientation X slash type interaction, $F(45, 2655) = 4.69$, $p < .0001$. These means are shown in Table 2. In general, this interaction reflects the following: For several pictorials, some orientations were less preferred due to the slash's intersection (overlap) with the pictorial making its critical features less apparent, and that this effect was larger for the over slash compared to the other slash types (as this slash type completely obscures the underlying features). The following pictorials showed this pattern: NO FLAMES; DON'T DRINK THE WATER; NO SMOKING, EATING OR DRINKING; DO NOT DIG; NO DIVING; AND KEEP OUT—HIGH VOLTAGE. Examples of obscured pictorials in the over condition are shown in Figure 3.

Table 2. *Mean Ranks as a Function of Slash Type (Over, Under, Translucent, and Partial) and Orientation (Left-I vs. Right-II).*

		Slash Type			
Pictorial	*Orient.*	*Over*	*Under*	*Trans.*	*Partial*
No Left/Right Turn	I	2.63	3.45	4.73	6.92
	II	2.40	3.78	5.10	6.98
No Flames	I	2.10	3.25	4.40	6.55
	II	3.30	4.12	5.10	7.18
Don't Drink Water	I	2.95	3.43	4.43	6.07
	II	3.55	3.78	4.73	7.05
No Smoking, Eating or Drinking	I	4.30	3.12	4.73	6.90
	II	2.33	3.13	4.60	6.88
No Entrance	I	2.95	3.57	4.77	6.90
	II	2.72	3.48	4.70	6.92
Do Not Touch Exposed Gears	I	4.13	3.17	4.65	6.38
	II	3.83	2.83	4.68	6.32
No Bicycling	I	3.05	3.28	4.73	6.97
	II	3.10	3.22	4.63	7.02
No Snowmobiling	I	2.80	3.42	5.10	6.85
	II	2.72	3.30	4.93	6.88
No Trucks	I	2.08	3.88	4.98	6.87
	II	2.27	3.77	4.98	7.17
No Dogs	I	2.97	4.00	5.28	7.05
	II	2.07	3.50	4.60	6.53
No Exit	I	2.55	4.55	4.37	6.73
	II	2.20	4.45	4.45	6.70
Do Not Touch Switch	I	2.67	3.58	4.72	6.98
	II	2.83	3.47	4.78	6.97
Do Not Dig	I	2.73	2.92	4.55	6.25
	II	3.93	3.57	5.08	6.97
No Diving	I	2.58	2.98	4.48	6.70
	II	3.83	3.47	5.13	6.82
Do Not Climb Tower	I	3.25	3.02	4.47	6.82
	II	3.67	3.17	4.78	6.83
Keep Out-High Voltage	I	3.68	2.78	4.10	6.57
	II	4.53	3.30	4.32	6.72

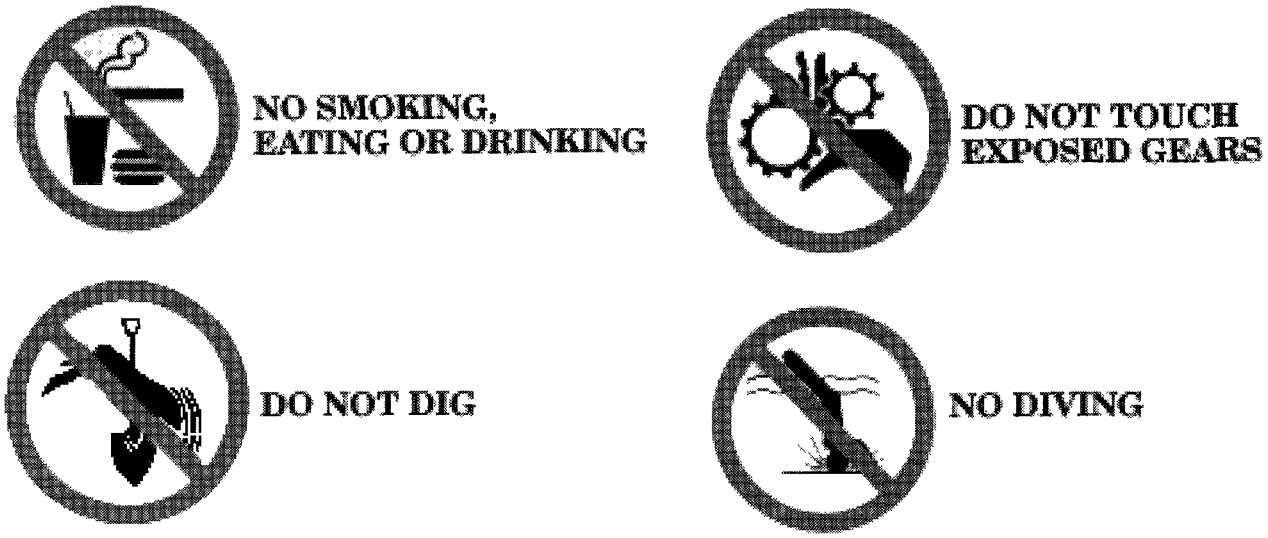
DISCUSSION

In general, the over and under slash types were the most preferred compared to the other two slash types. Next was the the translucent slash, and the least preferred was the partial slash. Therefore the results do not support the original hypothesis that the over slash would be least preferred. Nor does it support the hypothesis that the under slash would also receive relatively low evaluations. At least two possible reasons for these findings can be offered. First, familiarity could have influenced participants' preferences. Prohibitive signs commonly use the over slash The under slash is also used frequently as a negation method. People may prefer these slash types because they are familiar. Second, preference for the over slash compared to the other slash versions could be due to Gestalt principles such as goodness of form.

The results also do not support the prediction that participants would most prefer the translucent slash. There are at least two reasons why this slash version did not perform as well as expected. First, the translucent slash had reduced contrast in the area where the color of the slash changes to gray as it crosses the pictorial; this type of alteration might have limited its legibility. Second, observers might view the section with the color change as a separate, distinct part rather than perceiving the whole pictorial as a unit.

The partial slash received the worst evaluations probably because the slash itself was the least noticeable. The size of the two parts varied as a function of the pictorial's dimensions

Figure 3. Examples of Obscured Pictorials in Over Slash Condition.



and features. For some pictorials, the stubs of the partial slash were shorter and less apparent than for other pictorials. Evaluations of the partial slash might have been better had the stub tips stopped just short of the pictorial and had edges reflecting the pictorial's adjacent contours.

The failure to find positive results for the partial slash is contrary to Dewar's (1976) glance legibility findings. In his study, recognition performance was the best for the no slash and partial slash conditions compared to the over slash. However, Dewar (1976) used a different methodology than we did. Research by the current authors is underway in which these pictorials are being evaluated using a glance legibility method similar to Dewar's (1976) but instead employing free recall rather than a matching procedure as he did.

While the over and under slash were the most preferred negation methods in general, there were several exceptions to this pattern. In certain cases, some pictorials in a particular orientation and slash type produced dramatically lower evaluations. Largely, these exceptions occurred when critical pictorial details were obscured by the slash. In particular, this effect was most frequently evident with the over slash than with the other slash types. Apparently participants believed that concealing important features would negatively affect their interpretability.

The present results provide useful recommendations for warning designers. These data suggest that careful consideration on the pictorial's placement with respect to the slash is important. In some cases, the problem of concealment can be solved by changing the orientation of the pictorial. Sometimes, however, the concept might have to be represented by a different or modified pictorial so that all important features are visible.

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