Effects of Warning Border Color, Width, and Design on Perceived Effectiveness

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Abstract. There is limited research on the effects of the presence and the types of border surrounding warning text. The present study tested 51 borders formed by combining different characteristics of color, design, and width. Seventy-two participants rated these borders on one of three dimensions: (1) attention-gettingness, (2) likelihood to read the warning, and (3) connoted hazard of the border. Results show that a warning with a surrounding border is rated more salient than one without a border. Borders in red were rated highest, followed by yellow, green, and blue respectively; black borders were rated lowest. The highest rated border designs were the thicker alternating stripe, saw tooth, and inward arrow patterns. The lowest rated border was a thin black line. These results have implications for enhancing warning noticeability.

1. Introduction

To be effective, warnings must attract attention, be understandable, and promote safe behavior [1]. The attention-getting stage is considered the crucial first step for subsequent processing and compliance, and consequently, aspects that enhance the attention-capture are among the most studied variables in warning research. Since the mid 1980s, a number of perceptual factors have been identified that enhance the noticeability of warnings, including size, color, pictorials, and icons. Another attribute that might increase warning noticeability is the presence of a border surrounding the warning message. The effects of warning borders have not received much attention in the empirical literature, and the research that exists is equivocal. Research has shown a negative effect [4], no effect [2,3], and a positive effect [5]. In the latter study, Edworthy and Adams [5] demonstrated that a thick red border surrounding a signal word (e.g., the term WARNING) significantly increases perceived salience.

The issue addressed in the present research was whether having a border around the entire warning text (not just the signal word) influences subjective measures of warning effectiveness. And if borders do make a difference, does it vary as function of the characteristics of the border? In the present study, 50 borders varying in color, design, and width plus one with no border were tested on perceived attention-gettingness, likelihood to read the warning, and connoted hazard.

Color was included because of its superior attention-gettingness characteristics [5], and its ability to convey hazard information [6]. Color can enhance warning salience, memory, connoted hazard, and compliance. Adams and Edworthy [5] showed that a red border surrounding the signal word is rated significantly more effective than a black border. In the present study, five colors are examined.

General perceptual principles suggest that a thick solid enclosure is preferable to a single line enclosure [7]. Adams and Edworthy [5] found a positive linear relationship between the border width around a signal word and perceived urgency. In the present study, the effect of three border widths are examined.

Previous research has shown that certain visual-spatial configurations in warnings (e.g., icons, shapes) vary in attention-attractingness and connoted hazard.[8]. However, border design has not been investigated before, and is examined in the present study.
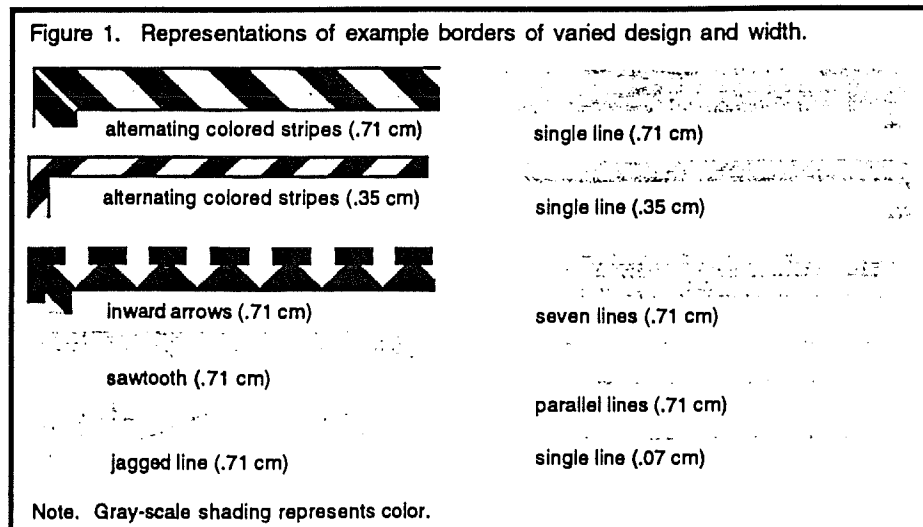
2. Method

2.1. Participants

Seventy-two participants from North Carolina State University participated to fulfill the requirements of their introductory psychology course.

2.2. Design

A set of fifty-one warning stimuli was used. Fifty of the warnings had borders while one had no border (control). The set of borders were formed by combining different characteristics of color, width, and design. Five colors were used: red, yellow, green, blue, and black. Seven designs were used: single line, parallel lines, seven parallel lines, jagged lines, saw tooth, inward arrows, and alternating color stripes. Each design and width was crossed with all five colors. Three widths were used for the single line design (.07 cm, .35 cm, and .71 cm), two widths were used for alternating colored striped pattern (.35 cm, .71 cm), and only the thick width (.71 cm) was used for the inward arrow, sawtooth, jagged line, seven line and parallel line design. Examples of the borders are shown in Figure 1.

2.3. Materials .

The stimuli were produced using an Epson Color Stylus II printer in 720 X 720 dpi on white paper. The warning message text was held constant. The text was printed in san serif font (Helvetica). The signal word WARNING was printed in 24-point bold capital letters on top followed by the main message in 18-point font: "Contains Methanol. Lung Disease Hazard. Avoid Breathing Fumes. Wear Respiratory Equipment and Protective Clothing When Handling." Each warning was printed and centered on separate sheets. In the 50 border conditions, a border surrounded the warning text (height by width was 10 X 15 cm). In the control condition, the warning text lacked a border. Each sheet was labeled with a number that was randomly assigned from 1 to 51. The stimuli were randomized for each participant and clipped to form a booklet. The response sheet contained 51 consecutively numbered blanks.

Figure 1.   Representations of example borders of varied design and width.

alternating colored stripes (.71 cm)   single line (.71 cm)

alternating colored stripes (.35 cm)   single line (.35 cm)

inward arrows (.71 cm)   seven lines (.71 cm)

sawtooth (.71 cm)

parallel lines (.71 cm)

jagged line (.71 cm)   single line (.07 cm)

Note. Gray-scale shading represents color.

2.4. Procedure

Participants were instructed to examine each stimulus page and rate it on one of three dimensions: (1) "How *attention-getting* (or noticeable) would this warning be if it were on a product?" (2) "If you saw this warning on a product, how likely is it that you would *read* it?" (3) "To what extent does this border *communicates a hazard*?" There were 24 participants per question. Participants responded using Likert-type scales anchored at end points with (0) "not at all" and (8) "extremely."

3. Results and Discussion

Table 1 shows the mean ratings for each of the 51 conditions. Table 2 shows the means as a function of color, design, and width (collapsed across conditions). The ratings for the three dimensions were relatively consistent. The tables show that a warning with a border is rated more salient than one without a border. Borders in red were rated highest, followed by yellow, green, and blue respectively; black borders were rated lowest. Thicker width borders were rated more salient than thinner borders. The designs rated highest were colored stripes, inward arrows, and saw-tooth shape.

The present findings confirm earlier research [5] which showed that increased thickness increased salience.

Table 1. Means for 51 border combinations of color, width, and design.

Configuration	Width	Attention	Read	Hazard	Configuration	Width	Attention	Read	Hazard
No border	NA	0.50	1.33	NA	Black line	I	1.38	2.21	2.83
Yellow line	I	1.54	2.33	2.21	Black parallel lines	III	1.71	2.92	2.63
Yellow parallel lines	III	1.92	2.71	2.54	Green line	I	2.08	2.38	2.71
Blue line	I	2.29	2.54	2.13	Green parallel lines	III	2.42	2.83	2.54
Black line	II	2.58	3.33	3.33	Red line	I	2.58	3.13	3.50
Blue parallel lines	III	2.63	2.79	2.46	Red parallel lines	III	2.96	3.88	4.38
Black line	III	3.04	3.83	4.04	Blue line	II	3.08	3.42	3.08
Black jagged line	III	3.08	3.75	4.13	Yellow jagged line	III	3.08	3.13	3.67
Black/white stripes	II	3.08	3.83	4.00	Green line	II	3.17	3.50	3.25
Black 7 lines	III	3.25	3.33	3.54	Yellow line	II	3.33	3.79	3.63
Black/white stripes	III	3.58	4.25	5.04	Blue line	III	3.58	4.42	2.92
Blue 7 lines	III	3.58	3.88	3.21	Green jagged line	III	3.71	4.13	4.21
Yellow 7 lines	III	3.75	3.75	3.25	Black inward arrows	III	3.83	4.75	3.96
Blue jagged line	III	4.00	4.33	3.79	Green line	III	4.08	4.38	4.13
Red line	II	4.13	4.88	5.42	Yellow saw-tooth	III	4.17	4.08	4.83
Yellow line	III	4.20	4.46	4.13	Black saw-tooth	III	4.21	4.58	4.58
Green 7 lines	III	4.21	4.42	3.25	Black/green stripes	II	4.38	4.46	4.88
Black and blue stripes	II	4.46	4.46	4.38	Blue saw-tooth	III	4.46	5.17	4.67
Red 7 lines	III	4.58	5.13	5.54	Red jagged line	III	4.75	4.83	5.79
Black/red stripes	II	4.75	5.42	6.50	Black/blue stripes	III	4.92	5.29	4.71
Black/green stripes	III	5.04	5.50	5.17	Green inward arrows	III	5.08	5.13	4.54
Red line	III	5.13	6.04	6.13	Green saw-tooth	III	5.50	5.21	5.38
Yellow inward arrows	III	5.58	5.86	5.04	Blue inward arrows	III	5.58	5.13	4.25
Black/yellow stripes	II	5.63	5.63	5.88	Red inward arrows	III	5.83	5.83	6.00
Red saw-tooth	III	6.04	6.33	6.63	Black/red stripes	III	6.08	6.17	6.58
Black/yellow stripes	III	6.25	6.71	6.71					

Note.   I = .07 cm, II = .35 cm, and III = .71 cm widths. NA = Not applicable.

Table 2. Means of color, design, and width (collapsed across conditions).

Configuration	Attention	Read	Hazard	Configuration	Width	Attention	Read	Hazard
COLOR				*WIDTH and DESIGN*				
Red	4.68	5.16	5.64	No border	NA	0.50	1.33	NA
Yellow	3.95	4.25	4.19	single line	I	2.52	1.98	2.67
Green	3.97	4.19	4.00	single line	II	3.78	3.26	3.74
Blue	3.86	4.14	3.56	single line	III	4.62	4.01	4.27
Black	2.97	3.68	3.81	Parallel lines	III	3.03	2.32	2.90
				Seven lines	III	4.10	3.88	3.78
				Jagged line e	III	4.03	3.72	4.32
				Saw-tooth	III	5.01	4.88	5.22
				Inward arrows	III	5.34	5.18	4.76
				Colored stripes	II	4.46	4.76	5.13
				Colored stripes	III	5.58	5.12	5.64

Note.   Attention = attention-gettingness, Read = likelihood to read warning, and Hazard = conveys hazard.
I = .07 cm, II = .35 cm, and III = .71 cm widths. NA = Not applicable.

The findings suggest that borders influence warning salience and that the extent of this influence varies with the characteristics of the border (color, width and design). A thin plain line borders is less effective than a red thick design (e.g., stripes, arrows).

The failure to find an effect or a negative effect of a border surrounding a warning in previous work [3, 4] may be due to the methodology employed (e.g., reaction time). Lateral masking by the adjacent border might have degraded performance under the conditions employed in those studies.

An unexpected finding was that green was rated rather closely to yellow. While yellow is frequently used as a hazard color, green is not. Why this was found is not clear; further investigation is needed to provide an explanation.

In summary, this research indicates that a border around a warning can enhance salience, convey hazard information, and increase people's willingness to read the warning.

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