Measuring Visual Search Time For A Product Warning Label As A Function Of Icon, Color, Column And Vertical Placement

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ABSTRACT

The first step in producing warning compliance is getting the user to notice the warning. Although research has examined various factors of consumer product warnings, very few studies have objectively measured the noticeability of warnings. In the present study one indicant of noticeability, response time, was measured as a function of several warning label factors. Specifically the experiment employed a 5 (icon) x 3 (color) x 2 (column) x 3 (vertical placement) design, plus a control condition. Participants indicated which of two given warnings was present on a simulated product label (an over-the-counter drug label was used) and the response time was measured. Later they were asked to rank a set of labels according to having the most to least noticeable warning. The presence of an icon and color produced significantly faster response times than their absence. The ranking data showed that people preferred icons and signal words presented in red. Implications for warning label design are discussed.

INTRODUCTION

There has been growing interest about warning effectiveness over the past two decades. The exact nature of what effectiveness is varies among researchers, but most of them would agree that it involves aspects of attention, comprehension, and compliance behavior. Wogalter and Laughery (1996) present an information processing model of warning compliance consisting of 5 stages: (1) attention, (2) comprehension, (3) attitudes and beliefs, (4) motivation, and (5) behavior. The present research evaluates factors related to the first stage – attention. The attention stage is important because it is the stage in which individuals orient to and focus on the warning. If a warning is not attended to, the effective processing of the warning is interrupted. One factor associated with the processes of attention relates to the prominence, conspicuity or salience of the warning relative to the environment or background in which it is embedded (figure-ground relationship). Generally with greater foreground to background prominence, the more noticeable the object (or stimulus) will be. Thus, increasing the noticeability of a warning will improve the chances that a person will attend to it.

Research has shown that adding a signal word, icon or color to the warning on a product label increases the perceived hazard of a warning, as well as, compliance behavior (Strawbridge, 1986; Wogalter, Magurno, Carter, Swindell, Vigilante & Daurity, 1995). While there are a large number of studies that have measured hazard connotation of warnings and features of warnings, few have actually attempted to measure objective indications of noticeability. In one of the few studies that have objectively measured noticeablility (as opposed to subjective evaluation). Laughery, Young, Vaubel and Brelsford (1993) studied whether color and the inclusion of an icon can make a warning more noticeable on alcoholic beverage labels. Participants searched for a warning on a bottle containing simulated product labels and their response time was measured. They found that both color and icon facilitated response time. Laughery et al. (1993) used only one color and one icon and used a relatively simple context in which the warnings appeared. The present study also examined color and icon but manipulated them. The present study also manipulated location (column and vertical placement) within a relatively complex product label context. Examined was whether these factors influence the time to find the warnings.

This study examined two colors (red and blue) to highlight parts of the warning relative to black text. Red has been found to be the color with the highest level of associated hazard (e.g., Chapanis, 1994, Wogalter et al., 1995). Blue was included to address the issue of whether the use of any color would improve search time for locating a warning, even one that has no hazard connotation (Wogalter et al., 1995). The third color condition was black, which was the same as the surrounding text.

There were five icon conditions (no icon, asterisk, signal icon, Mr. Yuk, and a skull-and-crossbones icon). The skull-and-crossbones symbol was used because it has been used to indicate high levels of hazard and more specifically to indicate poison (Wogalter et al., 1995). The Mr. Yuk symbol was designed by the Pittsburgh Poison Control Center to provide an icon to children to associate with hazardous substances. The signal icon (a triangle surrounding an exclamation point, also called the alert symbol) was included because it is already used on a wide variety of consumer product labels and containers (as per ANSI Z535.4, 1998). The asterisk was included to asses the notion that any graphic symbol, even one with no associated hazard connotation, would improve noticeability. In this study, the operational definition of noticeablility or attention gettingness is response time.

STANDRAL COLD TABLETS provide hours of effective multi-symptom relief of colds, sinusitis and flu. Each tablet contains a decongestant to temporarily relieve nasal congestion, sinus pressure and reduce swollen nasal passages; an antihistamine to temporarily relieve sneezing, runny nose, and watery eyes; and a pain reliever to temporarily relieve headache, body aches, minor sore throat pain and reduce fever. Each tablet is coated for easy swallowing. INDICATIONS: For the temporary relief of headache, nasal cong4estion, runny nose, sore throat, fever and minor aches and pains due to a cold and for sneezing and itchy, watery eyes due to hay fever or other upper respiratory allergies. DIRECTIONS: ADULTS: 2 tablets every 4 hours, not to exceed 12 tablets in 24 hours. CHILDREN (6-12): 1 tablet every 4 hours, not to exceed 5 tablets in 24 hours. Children under 6 years of age: consult a doctor.

WARNING: Keep this and all drugs out of reach of children. DO not take this product if you are taking sedatives or tranquilizers, without first consulting your doctor. Use caution when driving a motor vehicle or operating machinery. Do not exceed recommended dosage because at higher doses nervousness, dizziness or sleeplessness may occur. Do not take this product if you have a breathing problem such as emphysema or chronic bronchitis, glaucoma, heart disease, high blood pressure, thyroid disease, diabetes, or difficulty in urination due to an enlargement of the prostate gland, unless directed by a doctor.

DRUG INTERACTION PRECAUTION: DO NOT TAKE THIS PRODUCT IF YOU ARE PRESENTLY TAKING A PRESCRIPTION DRUG FOR HIGH BLOOD PRESSURE OR DEPRESSION, OR A MONAMINE OXIDASE INHIBITOR, WITHOUT FIRST CONSULTING YOUR DOCTOR. Do not take this product for more than 7 days or for fever for more than 3 days. If pain or fever persists or gets worse, if new symptoms occur, or if redness or swelling is present, consult a doctor because these could be signs of a serious condition. If sore throat is severe, persists for more than 2 days, is accompanies by fever, headache, rash, nausea, or vomiting, consult a doctor. As with any drug, if you are pregnant or nursing a baby, seek the advice of a health professional before using this product. In case of accidental overdose, seek professional assistance or contact a poison control center immediately. Prompt medical attention is critical for adults, as well as for children, even if you do not notice any signs or symptoms. ACTIVE INGREDIENTS: Each tablet contains Acetaminophen 325 mg, Phenylephrine HCl 5 mg and Chlorpheniramine Maleate 2 mg. INACTIVE INGREDIENTS: Calcium Stearate, Crescamallose, Sodium, S&C Yellow #10 Lake, FD&C Yellow #6 Lake, Hydroxypropyl Methylcellulose, Microcrystalline Cellulose, Polyethylene Glycol, Povidone, Starch, Stearic Acid. May also contain D&C Red #7 Lake, Pharmaceutical Glaze, Titanium Dioxide.

Figure 1. Example Label: Black, Skull-and-Crossbones, Left, Middle condition.

The column (left, right) in which the warning was placed and its vertical placement within the column (top middle, bottom) were manipulated to determine whether location mattered , and to prevent participants from anticipating the location of the warning.

METHOD

Participants

Forty undergraduates (23 male, 17 female) from introductory psychology courses at North Carolina State University participated for course credit.

Materials

The experiment was programmed in PsyScope 1.1 (Carnegie Mellon University, Pittsburgh, PA) and was run on a Power Macintosh computer with high-resolution color monitor. The simulated product labels were modeled after the back and side labels of a box of Dristan® Cold Tablets (Whitehall Laboratories, Madison, NJ). An example label is shown in Figure 1. For the ranking task, participants were given hard copies of the simulated product labels to sort.

Procedure

Participants' main task was to search for one of a given pair of warnings presented on the computer screen. Half looked for the two warnings "Keep this and all drugs out of

reach of children" and "Keep this and all drugs out of direct sunlight." The other half looked for the warnings "May cause drowsiness" and "May cause dizziness." Participants were to press one key for one warning and another key for the other. Warning pair and key mapping were counterbalanced across participants. Only one of the two statements of the pair was given on the label in any given trial. Each participant was randomly presented 192 different labels in the experiment. The warnings were placed in one of six places on the label: a 2 column (left, right) x 3 vertical placement (top, middle, bottom) manipulation. The warning was paired with an icon/signal word (WARNING) pair with one of 5 icon conditions (no icon, asterisk, signal icon, Mr. Yuk, and skull-and-crossbones) present. The icon/signal word was presented in one of 3 colors (black, red, and blue). In the red and blue conditions, the icon and or the signal word would both be presented in that color. In the control condition, there was no icon or signal word. The amount of time it took to discriminate which warning statement in the warning pair was present and to press one of two keys on the computer keyboard was measured in each trial.

After completing the entire set of response time trials, participants were then asked to rank order a set of labels according to them having the most to least noticeable warning. The labels were presented to the participants in a random order which was achieved by shuffling the cards and presenting them to the participants in a single stack. This set of labels included all of the color and icon conditions with the warning located in the same location (middle left column). The control condition with the warning placed in the same

location (middle left column) was also included. The participants were instructed to lay out the cards on a table in rank order of noticeability. The experimenter recorded the order.

RESULTS

Response Time

A 5 (icon) x 3 (color) x 2 (column) x 3 (vertical placement) analysis of variance (ANOVA) was carried out on the response time data. Table 1 shows the main effect means. Tukey's Honestly Significant Difference (HSD) test (at $p < .05$) was used to compare means of significant effects. The ANOVA showed a main effect of color, $F(4, 156) = 341.5$, $p < .05$. Icon/signal word pair presented in either red or blue produce significantly faster response times than when presented in black. There was no significant difference in response time between red and blue. There was a significant main effect of icon, $F(2, 78) = 184.9$, $p < .05$. No significant response time difference was found among the four icon present conditions. There was a significant main effect of column, $F(1, 39) = 18.4$, $p < .05$. Warnings placed in the left column ($M = 1.72$) were found significantly faster than those placed in the right column ($M = 1.92$). There was a significant main effect of vertical placement, $F(2, 78) = 20.5$, $p < .05$.

Response times for warnings placed at the top or middle sections of the label were significantly faster than those placed at the bottom section. There was no significant difference between the top and middle sections.

Table 1. Mean response times for main effects (in s)

Color	Mean
Blue	1.41
Red	1.46
Black	2.59

Icon	
Signal Icon	1.42
Mr. Yuk	1.45
Skull-and-crossbones	1.50
Asterisk	1.53
No Icon	3.19

Column	
Left	1.72
Right	1.92

Vertical Placement	
Top	1.65
Middle	1.78
Bottom	2.03

Control	10.57

Table 2. Average response times for two-way interactions with (in s).

Icon and Color

	Black	Red	Blue
No Icon	6.34	1.70	1.55
Asterisk	1.70	1.49	1.40
Signal Icon	1.62	1.33	1.32
Mr. Yuk	1.55	1.37	1.43
Skull Xbones	1.73	1.40	1.37

Icon and Column

	Left	Right
No Icon	2.58	3.81
Asterisk	1.54	1.53
Signal Icon	1.46	1.38
Mr. Yuk	1.46	1.44
Skull Xbones	1.55	1.45

Icon and Vertical Placement

	Top	Middle	Bottom
No Icon	2.62	3.22	3.74
Asterisk	1.44	1.43	1.73
Signal Icon	1.36	1.41	1.50
Mr. Yuk	1.38	1.38	1.59
Skull Xbones	1.44	1.45	1.61

Color and Column

	Left	Right
Black	2.24	2.94
Red	1.47	1.44
Blue	1.44	1.38

Color and Vertical Placement

	Top	Middle	Bottom
Black	2.19	2.56	3.01
Red	1.38	1.42	1.57
Blue	1.37	1.35	1.52

Column and Vertical Placement

	Left	Right
Top	1.64	1.65
Middle	1.65	1.90
Bottom	1.85	2.21

There was a significant interaction of icon and color, $F(8, 312) = 131.3$, $p < .05$. The top section of Table 2 shows these means. The condition in which the signal word was presented in black and not paired with an icon showed significantly slower response times than all other color/icon conditions, which did not differ among themselves.

There was a significant interaction of icon and column, $F(4, 156) = 39.1$, $p < .05$. Table 2 shows these means. When no icon was present, the warning was found significantly

Table 3. Average response time for three-way interactions (in s).

Color, Icon and Column

Color	Column	No Icon	Asterisk	Signal Icon	Mr. Yuk	Skull Xbones
Black	Left	4.42	1.71	1.67	1.59	1.79
Black	Right	8.26	1.72	1.56	1.50	1.67
Red	Left	1.72	1.48	1.36	1.37	1.44
Red	Right	1.68	1.50	1.30	1.37	1.36
Blue	Left	1.60	1.42	1.34	1.41	1.43
Blue	Right	1.49	1.37	1.30	1.44	1.32

Color, Icon and Vertical Placement

Color	V. Placement	No Icon	Asterisk	Signal Icon	Mr. Yuk	Skull Xbones
Black	Top	4.77	1.56	1.55	1.47	1.62
Black	Middle	6.44	1.59	1.59	1.49	1.71
Black	Bottom	7.82	1.99	1.71	1.67	1.86
Red	Top	1.63	1.38	1.28	1.29	1.33
Red	Middle	1.71	1.36	1.32	1.33	1.38
Red	Bottom	1.75	1.73	1.39	1.49	1.49
Blue	Top	1.47	1.38	1.25	1.37	1.38
Blue	Middle	1.52	1.33	1.32	1.32	1.26
Blue	Bottom	1.66	1.47	1.39	1.59	1.48

faster in the left column than in the right column. When any icon was present, there were no significant differences in response times found between columns
.   There was a significant interaction of icon and vertical placement, $F(8,312) = 6.2$, $p < .05$. Table 2 shows these means. When no icon was present, warnings placed in the middle of the column were found significantly slower than those at the top of the column and significantly faster than those at the bottom of the column. When an icon was present, it did not matter where the warning was placed in the column.

There was a significant interaction between color and column, $F(2, 78) = 34.0$, $p < .05$. Table 2 shows these means. When the icon/signal word pair was presented in black, the warning was found significantly faster in the left column than in the right column. When red or blue was used for the icon/signal word pair, which column the warning was placed in did not matter.

There was a significant interaction of color and vertical placement, $F(4, 156) = 7.7$, $p < .05$. Table 2 shows these means. When the icon/signal word pair was presented in black, warnings placed at the top of the column were found significantly faster than those placed in the middle of the column which in turn were found significantly faster than those at the bottom of the column. When an the icon/signal word pair was presented in red or blue, it did not matter where the warning was placed in the column.

There was a significant interaction of column and vertical placement, $F(2, 78) = 5.2$, $p < .05$. The bottom portion of Table 2 shows these means. The means show faster reaction times from top to bottom and from left to right. For example, warnings located in the bottom of the right column showed significantly slower reaction times than warnings in any other

position.

There was a significant interaction of color, icon, and column, $F(8, 312) = 5.2$, $p < .05$. These means are shown in the upper portion of Table 3. The conditions in which the warning was presented in black with no icon showed significantly slower reaction times than all other conditions. Within this group, warnings located in the right column were found significantly slower than warnings located in the left column.

There was a significant interaction of icon, color and vertical placement, $F(16, 624)$, $p < .05$. These means are shown in the bottom portion of Table 3. When the warning was presented in black with no icon present in all three vertical positions the reaction times were significantly slower than all other warning conditions. Within this grouping, warnings located at the bottom of a column were found significantly more slowly than those located at the top of a column. Warnings located in the middle of the column were found faster than those at the bottom of the column and slower than those at the top of the column, but were not significantly different from either of these.

Compared to the control condition ($M = 10.57$ s), all of the experimental conditions had significantly faster response times ($ps < .05$).

Ranking Data

While rank order data generally calls for non-parametric analysis, in this complex factorial design an ANOVA was used to explore the possibility of main effects and interactions. An ANOVA showed that there was a significant main effect for the ranking of individual labels, $F(15, 624) = 302.2$, $p <$

.05. There were also significant main effects found for icon $F(5, 634) = 51.3$, $p < .05$, and color, $F(3, 636) = 660.8$, $p < .05$. There was a significant interaction of color and icon, $F(8, 585) = 3.19$, $p < .05$. Also, all labels were ranked significantly higher than the control condition. The pattern of these data was almost identical to what was found in the response time analysis except that participants preferred red over blue, and icons with hazard connotation over one that does not, the asterisk.

DISCUSSION

The presence of an icon, regardless of which one, significantly reduced the search time for finding a warning on a product label. The presence of an icon with a signal word helps that area "pop-out" of the surrounding text possibly due to a pre-attentive search (Martin, McDonald, & Patton, 1987). The asterisk, an icon that probably has no connoted hazard, did not show significantly slower response times relative to those icons which had some hazard connotation. This particular result suggests that at least some icon should be used with warnings embedded in complex contexts. However, search time is not the only criterion for inclusion on a label. The icon chosen for a label should reflect the nature of the hazard. If the product contains a poisonous substance, one might want to use the skull-and-crossbones icon, or Mr. Yuk, but not the asterisk. The response time data only measured noticeablilty, not hazard connotation. In fact the rank order task showed a preference for warnings with icons that have some hazard connotation over the asterisk. This latter result confirms other research (Wogalter, Magurno, Frederick, & Herrera, 1997; Wogalter, Kalsher, Frederick, Magurno, & Brewster, 1998). The rank order test appears to assess somewhat different aspects than the response time task. The ranks were apparently influenced by the hazard connotation of the presented colors and icons.

The study showed that there was also a substantial effect of the addition of a different color than the rest of the text to a warning on a product label. Response times were reduced showing that people were finding the warnings faster when they had the colors red and blue relative to black which was the same color as the rest of the text (black). The presence of a different color on a label with uniform black text helps that area "pop-out" of the surrounding text probably due to a pre-attentive search. Although no difference in response time was found between searching for warnings placed next to a red icon/signal word pair, and one next to a blue icon/signal word pair, the choice on which to use should take into account the colors' connoted hazard. Several studies have shown that red connotes a greater hazard than blue (Wogalter et. al., 1997; Wogalter et. al., 1998). Even though no difference was found in response time between the two colors, people tended to prefer red over blue in the sorting task. Thus, the results show that color and/or icon makes it easier to find a warning.

This study also showed that a warning's location on a label can affect how easy it is to find. Warnings placed at the top of a column were found faster than those placed at the bottom of a column. Warnings placed in the left column were found faster than those placed in the right column. Thus, to give a warning a better chance of being noticed, it should be placed at the top of the column and should not be placed at the bottom of the right column.

This study builds a foundation on which more complex studies can be based. Subsequent research should look at the effects of additional icons or colors that are competing with the salient icon for the attention of the user. Future research could examine the effects of features surrounding the warning on an actual product label. Research could also look at using a program to present the labels in a more realistic way on the computer, such as in an interactive 3D environment.

The results of this study indicate that minor changes such as the addition of an icon or color can improve warning noticeability on product labels.

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