Communication of Alcohol Facts and Hazards by a Warning Poster

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Two experiments were conducted to determine whether a warning poster would effectively convey alcohol-related information to college students. In experiment 1, a warning poster containing alcohol facts was posted at several social fraternities. Students' knowledge of alcohol hazards increased after exposure to the warning, though much of the information was already known. In experiment 2, the poster was refined and included less-well-known facts. Students knowledge increased after exposure to the poster. These results show that posted warnings can effectively communicate important information to one "at-risk" group, college students. Suggestions for improvement and potential utility for other groups at risk are discussed.

Alcohol abuse and alcoholism are among the most serious public health problems affecting the United States. Indeed, the National Highway Traffic Safety Administration (NHTSA) reports that approximately 49% of the 50,000 annual highway fatalities in the U.S. are attributed to the use of alcohol [NHTSA 1990]. The costs associated with the use of alcohol account for nearly 20% of this nation's $427 billion annual health care costs [Kinney 1991].

These and other problems of alcohol abuse led Congress to mandate the following alcohol warning label on all beverage alcohol containers sold in the U.S. [Alcohol Beverage Labeling Act 1988]:

> GOVERNMENT WARNING: (1) ACCORDING TO THE SURGEON GENERAL, WOMEN SHOULD NOT DRINK ALCOHOLIC BEVERAGES DURING PREGNANCY BECAUSE OF THE RISK OF BIRTH DEFECTS. (2) CONSUMPTION OF ALCOHOLIC BEVERAGES IMPAIRS YOUR ABILITY TO DRIVE A CAR OR OPERATE MACHINERY, AND MAY CAUSE HEALTH PROBLEMS.

In addition, several states, including New York and California, have mandated that alcohol warnings be posted at all establishments that sell beverage alcohol, including bars, taverns, restaurants, and liquor stores.

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Concurrent with the passage of the law requiring alcohol warning labels, several large-scale surveys were undertaken to assess its impact [Hilton 1992]. Criteria employed as indices of effectiveness ranged from simple awareness of the label to measures of risk perception and behavior change [Kaskutas and Greenfield, in press, 1991; Mazis, Morris, and Swasy 1991]. In general, these studies suggest that beneficial effects associated with the label have been weak at best [Hilton 1992]. For example, Mazis and his coauthors conducted a large-scale telephone survey to determine perceived risk of alcohol use and awareness of the government-mandated warning six months before and six months after the appearance of the warning label. Their results showed a slight increase in respondents' perceptions of risks associated with alcohol consumption after implementation of the warning label. More interesting, though, is the observation of a differential impact of the warning across demographic groups and reported alcohol consumption levels. These results suggest that the effectiveness of alcohol warnings may depend on the extent to which they meet the special needs of specific "target" groups. Such a suggestion is not new, however, and forms the basis for much of the social marketing literature, which dictates development of interventions commensurate with characteristics of specific target populations by consideration of the "4 p's" (person, price, product, and promotion).

A conceptual framework proposed by Geller et al. [1990] reinforces the importance of acknowledging individual differences during the development of intervention techniques. Geller and his associates propose a taxonomy of behavior change strategies that can be used, alone and in combination, to provide more information to effect beneficial behavior change across target populations and problems. They argue that intervention effectiveness depends on the extent to which interventions meet the needs of target groups, especially groups consisting of individuals most likely to engage in risky behaviors, including excessive alcohol consumption.

Several reasons have been offered for the observed limited effectiveness of the government-mandated warning. For example, research by Laughery and his associates [Godfrey et al. 1991; Laughery and Brelsford 1991; Laughery and Young 1991] tends to confirm the widely shared perception that many manufacturers' labels have format and design characteristics that make them difficult to notice. Moreover, information conveyed by the warning is either already well known to most of the public, irrelevant to the life circumstances of many segments of the population, or both. Hence, the current warning may need to be supplemented with dissemination techniques that convey alcohol-related information that is consistent with the beliefs, attitudes, knowledge, and concerns of intended target groups [Patterson, Hunnicutt, and Stutts 1992; Smith 1990]. Moreover, after viewing the information contained in the current warning once, or even a limited number of times, consumers may "tune the warnings out." Several studies indicate that presenting already known information has little impact because the behavior has already been schematized or scripted. Thus, the individual continues to engage in previously learned behaviors [Abelson 1976; Bhalla and Lastovicka 1984]. Previously known information may also attenuate the impact of warning labels because of familiarity of the message and its format [Elliot 1989; Mazis, Morris, and Swasy 1991]. In these instances, scripted behavior may be triggered, reducing the processing of messages or warnings that have similar information content and format [Bhalla and Lastovicka 1984].

Currently, there is only limited research to guide the design of better alcohol warnings, and most of this research has focused on formatting characteristics of the present warning message (e.g., Godfrey et al. 1991; Laughery and Young 1991; Young 1991), awareness of the warning [Mazis, Morris, and Swasy 1991], and believability of the warning content [Andrews, Netermeyer, and Durvasula 1990]. Research is lacking on alternative ways for conveying alcohol-related hazards to specific target groups [Hilton 1992; Smith 1990].

One model that shows promise for improving alcohol warnings is based on communication theory. When warnings are viewed as communications [Laughery and Brelsford 1991], it is important to consider how components of the model relate to the current alcohol warning, including the source of the warning (federal government, Surgeon General), the channel or medium through which the message is conveyed (labels on beverage alcohol containers; television, radio, or magazine ads), the message content (current warning or other proposed warnings), and the receiver (the general public, specific target groups, individuals). Though not explicit in the basic communication model, ensuring an optimal fit among each of the components is critical [Andrews, Netermeyer, and Durvasula 1990]. In other words, warning effectiveness depends on the extent to which the message content and presentation format are consistent with characteristics and needs of receivers to whom the information is directed.

When evaluated in the context of the communication model, the warning label currently required on alcoholic beverage containers is not optimal for a variety of reasons. First, because of its small size, drinkers of alcohol may be unable to read or even see the warning message, especially as they become increasingly intoxicated. Second, the current alcohol warning label lacks conspicuity as it is often indistinguishable from other information (e.g., ingredients) on the label. Third, certain parts of the warning are not specific, and hence, may not convey the intended information effectively. For example, the label warning states that alcohol may cause health problems, but does not specify the type or severity of those problems. Fourth, the warning is found only on beverage alcohol containers, and therefore, when a beverage is served outside the original container (e.g., in a cup, glass, mug) or served from a keg or by some other bulk service method, the drinker does not have the opportunity to view a warning. Finally, the warning lacks important message components. It does not contain specific information relevant to high risk groups other than pregnant women (e.g., college students, persons taking certain prescription drugs). Such information would include (1) the danger of consuming alcohol with other drugs, (2) the potential legal liabilities of drinking and driving, (3) the effects of alcohol on performance other than driving or operating machinery (e.g., cognitive tasks), and (4) the effects of alcohol on the body (e.g., cancers, brain damage).

A group particularly at risk from alcohol consumption, and therefore in need of effective alcohol warnings, is college students [Berkowitz and Perkins 1986]. Though average per-capita consumption of beverage alcohol in the U.S. has actually decreased over the past decade, alcohol consumption by college students has remained nearly constant [Kinney 1991]. Between 70 and 96% of U.S. college students drink alcohol, and as many as 25% of them are heavy drinkers [Kivilan et al. 1989]. Students' self-reported problems due to drinking include lower grades, missed classes, hangovers and vomiting, drinking-driving, and higher dropout rates [Engs and Hanson 1989]. Moreover, national surveys suggest that alcohol consumption among college students has remained constant over the past decade, despite a 33% decline in the use of other drugs during the same period. In comparison with their peers who do not attend a university, college students are more likely to drink and are, in general, heavier drinkers. The reason may be the increased freedom and independence that accompany living away from home. In contrast, persons who do not attend college are more likely to live at home or be married, both of which are associated with less drinking. In addition, individuals attending college are likely to experience greater social and academic pressures while at school, which may also enhance alcohol drinking behavior.

The fact that most college students are between the ages of 16 and 24 years also places them at increased risk from alcohol consumption, as the leading cause of death for individuals in this age group is driving while intoxicated (DWI). Unfortunately, attempts to alter the drinking behavior of college students by using educational materials that emphasize the harmful effects of alcohol have not succeeded. The ineffectiveness of these educational campaigns may be due to a conflict between the negative information provided and the personal experiences of many college students who find drinking to be pleasurable [Kivilan et al.

1989]. Because of this conflict, it is critical that warnings researchers exercise care when developing alcohol warnings for this age group.

A poster (large placard) might be an efficient means for conveying the hazards of alcohol consumption to college students because it (1) can be made more conspicuous than the current label warning and is more likely to attract attention, (2) can be constructed to complement and/or extend the information contained in the current warning label, (3) can incorporate information most relevant to persons in this age group, (4) does not require that the drinker be near the alcohol bottle or can, and can be seen when alcohol is served from a keg or by some other bulk method, (5) allows for inclusion of important information too voluminous for a single beverage alcohol container label, (6) does not require that a person consume alcohol to learn about alcohol hazards, and (7) allows placement at tactical locales that would promote its being read (e.g., bathroom stalls, elevators, meeting rooms).

Though the use of posters to convey safety information is not a new concept, only a few demonstrations of their effectiveness have been reported. Laner and Sell [1960] and Saarela [1989] showed that posters are effective in decreasing unsafe behavior in field settings. In addition, Saarela showed that a poster campaign increased workers' knowledge of job-related hazards. In a more recent study, Ferrari and Chan [1991] used posted warning signs to encourage university students to reduce the sound volume of their portable stereo headphones. The posters contained a drawing of a portable cassette player inside a red circle with a red diagonal line through the figure. Above the drawing was the word "WARNING" and underneath was the statement: "Long exposure to high intensity sounds can contribute to 26% hearing loss among college students. Please *Turn Down the Sound*. Thank you." After implementation of the posted warning intervention, the percentage of college students listening to their stereo headsets at high volume declined significantly. Though posters are a commonly used technique to convey information, systematic research is necessary to determine what makes a poster effective and for whom it is effective. College students are usually thought to be a reasonably homogeneous "target" group, but growing evidence suggests that this is not the case. For example, Hughes, Power, and Francis [1992] found that college students drink for a variety of reasons (e.g., coping with negative states, enhancing positive states, peer pressure), even when quantity and frequency measures are controlled for. Schall, Kemeny, and Maltzman [1992] report similar "push-pull" forces that affect students decisions to drink and suggest that it may be necessary to develop innovative educational techniques, including effective posters, to decrease approach tendencies to drink and increase avoidance tendencies.

We report the results of two experiments assessing the effectiveness of a posted warning designed to increase college students' knowledge of alcohol-related facts. In experiment 1, a warning poster containing facts believed to be relevant to college-age drinkers was constructed and then tested to determine its efficacy in increasing students' knowledge of alcohol-related hazards. On the basis of the results of experiment 1, the posted warning was redesigned and then tested in experiment 2 to determine its novelty and efficacy in increasing students' knowledge of alcohol-related facts. Therefore, the research hypotheses for experiments 1 and 2 were very similar. Specifically, we expected that participants exposed to the poster intervention would demonstrate greater knowledge of alcohol-related facts and hazards than participants not exposed to the intervention.

Experiment 1

Method

Participants and Setting

The participants were 134 undergraduate and graduate students at a medium-size private technical university in the northeastern United States. Their ages ranged from 18 to 25 years, and 50 were under 21 years of age, the legal drinking age in New York State. The study was conducted at eight campus social fraternities. Two social fraternities were assigned randomly to each of four experimental conditions.

Warning Poster

A 30.5 by 45.7 cm (12 by 18 in) three-color poster containing alcohol-related information considered relevant to college-age students was developed (Figure 1). The entire poster was covered with plastic lamination to increase its durability. Alcohol-related information was presented in five knowledge categories: death and injury, legal liability and penalties, performance while under the influence of alcohol, physiological effects, and use of a blood alcohol concentration (BAC) nomogram. The signal word CAUTION and an accompanying triangle/exclamation point icon were placed at the top of the poster.

Development of Pictorials

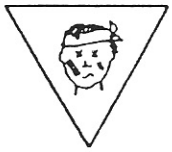
A yellow and black colored pictorial depicting a potential hazard for each category was placed to the left of the category heading and accompanying text. The purpose of the pictorials was to capture the participants' attention and communicate the hazards associated with a particular category quickly. The pictorials used on the poster were selected on the basis of a preliminary study in which two artists initially drew several possible pictorials for each category. Later, 10 individuals were given verbal descriptions of each category and asked to choose which among a number of pictorials best represented the category. The pictorials chosen most often were used on the poster.

Verbal Content

The verbal content of the poster consisted of alcohol-related facts based on information obtained from published research articles, New York State and federal government technical reports and manuals, National Safety Council's [1989] *Accident Facts*, and a training manual for servers of alcohol [Health Education Foundation 1985].

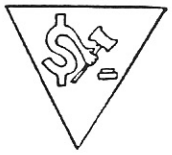
Figure 1. Alcohol Warning Poster Used in Experiment 1[a]

⚠ CAUTION



Death & Injury

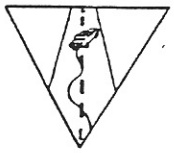
- o 14,000 people age 16 to 24 are killed and hundreds of thousands are seriously injured in preventable traffic crashes each year.
- o Drivers 24 and under represent 16% of the driving population, but are involved in over 44% of the alcohol-related traffic crashes.
- o Over 50% of all traffic deaths are caused by alcohol.
- o As many as 90% of all the fatally injured drinking drivers are male.
- o The majority of alcohol-related traffic crashes are caused by individuals who have not been identified as problem drinkers.



Liability

In addition to financial law suits brought against you, your parents, your fraternity, and your university, did you know that in New York State:

- o The MINIMUM penalties for 1st offenders convicted of driving while alcohol impaired (DWAI) or driving while intoxicated (DWI) are:
  - DWAI (BAC ≥ .05): 90-day suspension of driver's license, 15 days in jail, and $250 fine.
  - DWI (BAC ≥ .10): 6-month revocation of driver's license, 1 year in jail, and $350 fine.
- o The MAXIMUM penalties for repeat convictions of these offenses are:
  - DWAI: 6-month revocation of driver's license, $1500 fine and 90 days in jail.
  - DWI: 1-year revocation of driver's license, $5000 fine and 4 years in prison.
- o Chemical test refusal will result in a 6-month revocation of driver's license and $100 fine.
- o Minors who refuse chemical tests will lose their license for 1 year or until they reach 21 years of age, whichever is the greater penalty.
- o Insurance costs increase dramatically following conviction of DWAI or DWI.



Performance

- o Response time and overconfidence in one's driving performance increases with each additional drink.
- o Drugs and medicines, when combined with alcohol, dramatically affects driving response times and overconfidence.

Alcohol Consumption Facts

- o In general, the major factor determining individual differences in blood alcohol concentration (BAC) is overall body weight.
- o Individuals with a high percentage of body fat will attain a greater BAC than same-weight, low body fat individuals if both drink at a similar rate.
- o Regardless of hot coffee, cold showers, or vigorous activity, your body processes alcohol at a constant rate of approximately .25 oz. of alcohol per hour.
- o The following measured amounts of beverage contain approximately 0.5 oz. of alcohol:
  - 12 oz. can of regular beer (4.2% alcohol)
  - 4 oz. glass of wine (12% alcohol)
  - 1 oz. "shot" of 100 proof spirits (50% alcohol)
  - 1.25 oz. "shot" of 80 proof spirits (40% alcohol)
- o Eating food before and during alcohol consumption slows the rate at which alcohol is absorbed.
- o Carbonated beverage alcohol (beer, champagne) will increase the rate at which alcohol is absorbed.
- o Because every person's metabolism is different,

Don't Feel Compelled to Keep Up With Anyone Else's Drinking.

Do You Know Where You Stand? Know Your Own Limits

Instructions: Count up all the drinks you've had. Then, subtract 1 drink for every 2 hours that have elapsed since you began drinking. Now, locate your approximate BAC on the chart below. Remember, this is only an estimate and does not take into account other important factors like those mentioned above.

	Number of Drinks											
		DWAI			DWI							
Body Weight	1	2	3	4	5	6	7	8	9	10	11	12
100	.038	.075	.113	.150	.188	.225	.263	.300	.338	.375	.413	.450
120	.031	.063	.094	.125	.156	.188	.219	.250	.281	.313	.344	.375
140	.027	.054	.080	.107	.134	.161	.188	.214	.241	.268	.295	.321
160	.023	.047	.070	.094	.117	.141	.164	.188	.211	.234	.258	.281
180	.021	.042	.063	.083	.104	.125	.146	.167	.188	.208	.229	.250
200	.019	.038	.056	.075	.094	.113	.131	.150	.169	.188	.206	.225
220	.017	.034	.051	.068	.085	.102	.119	.136	.153	.170	.188	.205
240	.016	.031	.047	.063	.078	.094	.109	.125	.141	.156	.172	.188

[a]Actual dimensions were 30.5 by 45.7 cm. The areas around the signal word and pictorials were in bright fluorescent yellow.

Table 1. Overall Knowledge, Knowledge Category, and BAC Nomogram Performance Means and Standard Errors for Each Experimental Condition in Experiment 1

	Experimental Condition							
	PNP		PIP		NNP		NIP	
Outcome Measure	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Overall knowledge	.65	.69	.72	.77	—	.67	—	.79
	.04	.03	.03	.03		.04		.02
Death and injury	.34	.39	.40	.49	—	.36	—	.46
	.04	.05	.03	.04		.03		.04
Legal liability	.31	.31	.34	.33	—	.30	—	.34
	.03	.02	.02	.02		.02		.01
Performance	.69	.68	.69	.76	—	.69	—	.69
	.04	.03	.04	.04		.03		.03
Physiological effects	.65	.67	.68	.77	—	.75	—	.78
	.03	.03	.03	.03		.02		.02
Correct use of BAC nomogram	.07	.14	.07	.57	—	.11	—	.51
	.05	.07	.05	.09		.05		.08

Dependent Measures

A 36-item alcohol knowledge survey was developed to assess participants' knowledge of information contained on the warning poster. Twelve fill-in-the-blank items were designed to measure knowledge of current New York State laws pertaining to the minimum and maximum penalties for driving while alcohol impaired (DWAI) and driving while under the influence of alcohol (DWI). Twenty-three multiple-choice items were also used to assess knowledge of information presented in the four knowledge categories. A problem-solving question was included to determine participants' ability to use the BAC nomogram to estimate alcohol impairment.

Design

The experiment was a Solomon four-group Design [Rosenthal and Rosnow 1984; Solomon 1949]. This design enabled us to examine not only the effect of intervention, but also (1) possible sensitization to or contamination of the intervention and/or posttest because of exposure to the pretest and (2) the difference between the pretest and posttest attributable to the time of testing. Each fraternity was assigned randomly to one of the following conditions: pretest, no intervention, posttest (PNP, $n = 28$); pretest, intervention, posttest (PIP, $n = 30$); intervention, posttest (NIP, $n = 39$); or posttest only (NNP, $n = 37$). Because the experimental protocol prevented tracking of particular participants over time (to preserve anonymity), matching pretest and posttest scores was not possible. The opportunity to pair scores of individual participants would have enabled us to use a more powerful repeated-measures approach to analyze the difference between pretest and posttest scores of the PNP and PIP groups. Instead, we used a more conservative between-subjects analysis.

Procedure

Participants in the pretest conditions completed the alcohol knowledge survey at their weekly fraternity meeting. Then, four warning posters were placed in each fraternity house assigned to the intervention groups. Posters were placed in high traffic areas (e.g., meeting rooms, general bulletin boards, kitchens, and bathrooms). No warning signs were placed in the fraternity houses assigned to the no intervention groups. The warning posters remained in place for two weeks and were then removed. One week later, all participants completed the alcohol knowledge survey at their weekly fraternity meeting.

Results

Survey items that were answered correctly received a score of one and those answered incorrectly received a score of zero. The total for each participant was divided by the total number of items to yield proportion-correct scores for overall knowledge, each of the four knowledge categories, and BAC nomogram performance (Table 1). The Solomon design requires analyses to determine the equivalence of conditions, changes in knowledge from pretest to posttest, and posttest knowledge differences. Initial analysis of the overall knowledge scores for the PIP and PNP groups by a 2 (age: under age 21, age 21 and older) × 2 (intervention: poster, no poster) × 2 (time of testing: pretest, posttest) between-subjects analysis of variance (ANOVA) indicated no significant main effect for age or interactions with age ($p > .05$). Therefore, the data were collapsed across age for all other analyses.

Equivalence of Conditions

One-way between-subjects ANOVAs for participants' scores on the pretest of the PNP and PIP groups and the posttest of the NNP group indicated no significant difference

among the means for either overall knowledge of alcohol-related information or use of a BAC nomogram ($ps > .05$). Thus, groups were equivalent in both knowledge and BAC nomogram performance prior to the intervention and across time when no intervention was present. Further analyses to determine the equivalence of groups were conducted on posttest knowledge and BAC nomogram performance scores. These analyses indicated no significant differences between posttest scores of the no poster groups (PNP and NNP) or between posttest scores of the poster groups (PIP and NIP) ($ps > .05$).

Analysis of Pretest to Posttest Changes: Knowledge of Alcohol-Related Information

The overall knowledge scores and scores for each knowledge category of the PNP and PIP groups were analyzed by a 2 (intervention: poster, no poster) × 2 (time of testing: pretest, posttest) between-subjects ANOVA. Results indicated a main effect of intervention ($F_{1,112} = 4.76$, $p < .05$). Participants in the poster condition had higher mean scores (M = .75) than participants in the no poster condition (M = .67). We found no other significant effects for overall knowledge ($p > .05$), and no significant differences among the individual means ($p > .05$) for the four knowledge categories.

Analysis of Pretest to Posttest Changes: Use of a BAC Nomogram

A separate analysis of participants' ability to use the BAC nomogram indicated a significant intervention by time of testing interaction ($F_{1,112} = 10.26$, $p < .01$). Simple effects analysis indicated that performance among participants in the poster condition increased significantly from pretest (M = .07) to posttest (M = .57) ($p < .05$), but there was no increase in performance for participants in the no poster condition ($p > .05$). We found no difference in participants' pretest performance across intervention conditions ($p > .05$), but participants' posttest performance was significantly greater in the poster condition (M = .57) than in the no poster condition (M = .14) ($p < .05$).

Analysis of Posttest Scores: Knowledge of Alcohol-Related Information

A 2 (intervention: poster, no poster) × 2 (pretest: present, absent) between-subjects ANOVA indicated a main effect of intervention ($F_{1,130}$) = 11.05, $p < .01$). Participants in the Poster conditions had higher overall knowledge scores (M = .78) than participants in the no poster conditions (M = .68). Separate 2 × 2 ANOVAs for each knowledge category indicated a significant increase in knowledge for two categories: alcohol-related death and injury ($F_{1,130} = 8.37$, $p < .01$), and the physiological effects of alcohol consumption ($F_{1,130} = 6.20$, $p < .05$). Participants' knowledge of death and injury (M = .48) and physiological effects (M = .78) was significantly greater in the poster conditions than participants' knowledge of death and injury (M = .37) and physiological effects (M = .71) in the no poster conditions. Of the five death and injury facts, two showed significantly greater knowledge for participants in the poster conditions than for those in the no poster conditions: knowledge of peer-age alcohol-related traffic crashes and knowledge about the proportion of problem drinkers involved in alcohol-related accidents. Of the eight physiological facts, two showed significantly greater knowledge for participants in the poster condition than for those in the no poster condition: knowledge about the rate at which the body processes alcohol and knowledge of the amount of alcohol in a 1.25-oz portion of 80 proof spirits.

Analysis of Posttest Scores: Use of a BAC Nomogram

Results indicated a significant main effect of intervention ($F_{1,130} = 30.41$, $p < .001$). Participants in the poster conditions were significantly more successful at correctly determining personal levels of blood alcohol content by using a BAC nomogram (M = .54) than participants in the no poster conditions (M = .12) ($p < .05$). No other effects for BAC nomogram performance were significant.

Discussion

The posted warning used in experiment 1 significantly increased participants knowledge of alcohol-related information. Groups exposed to the warning poster received a mean posttest score of .78, whereas groups not exposed to the poster received a mean posttest score of .68, a difference of 13%. Thus, on average, participants in the poster conditions answered 3.4 more questions correctly than their counterparts in the no poster conditions. Moreover, comparison of these groups' posttest scores for each of the four knowledge categories revealed that groups exposed to the warning poster had significantly higher posttest scores in two of the four knowledge categories (i.e., death and injury, physiological effects of alcohol) and for performance on the BAC nomogram. These findings are consistent with the results of previous studies showing that posters can be an effective means of conveying safety-related information. Additionally, the Solomon design allowed important comparisons between conditions that ruled out any possibility of sensitization or contamination due to the pretest or passage of time.

Though these results are encouraging, several caveats warrant mention. The failure to detect significant pretest-posttest differences for the PIP group was puzzling. Participants in the PIP group demonstrated significant improvement in their ability to use a BAC nomogram in comparison with their PNP counterparts, but such an improvement was not observed for their overall knowledge scores or their scores on each of the individual knowledge categories. There are several possible explanations for the modest increase in knowledge for this group. First, because university policy requires complete anonymity for study participants, especially when issues of alcohol are involved, we were not able to match participants' pretest and posttest scores. Therefore it was necessary to use a between-subjects design. Had it been possible to match participants' pretest and posttest scores, a more powerful within-subjects design might have yielded significant results. Second, though each fraternity was assigned randomly to conditions of the Solomon design, by chance the group scoring highest on the pretest was assigned to the PIP condition. This assignment may have indirectly produced a type of ceiling effect. A third

and related possibility is the content of the warning poster. We presumed that information included on the poster was not common knowledge. However, the results of the pretest (overall and by individual category) suggested that students knew much of the information prior to implementation of the warning poster. Indeed, the mean pretest score collapsed across all conditions was nearly .65, suggesting that participants knew most of the information on the poster before the intervention.

The results of experiment 1 suggested the need for improvements in the design of the warning poster. It had included information that was already well known to study participants. Experiment 1 also involved a relatively insensitive design for comparing the pretest and posttest scores because of the need to preserve the anonymity of participants. Experiment 2 had two major improvements, the use of less-well-known information in the poster contents and the use of a more sensitive within-subjects design.

Experiment 2

Method

Participants and Setting

The participants were 84 male undergraduate students. Their ages ranged from 18 to 23 years. Forty-six were under 21 years of age, the legal drinking age in New York State. The study was conducted at several campus social fraternities. Fraternities were assigned randomly to one of four experimental conditions.

Warning Poster

A 30.5 by 45.7 cm (12 by 18 in) three-color poster containing alcohol-related information was developed on the basis of the results from experiment 1 (Figure 2). Alcohol-related information was presented in six knowledge categories: death and injury, sexual performance, health consequences, liability, alcohol consumption facts, and use of a BAC nomogram. The signal word CAUTION and an accompanying triangle/exclamation point icon were placed at the top of the poster.

Development of Pictorials

Selection of the pictorials was accomplished by pretesting the original pictorials from Experiment 1 and a set of new pictorials designed to represent the knowledge categories used in experiment 2.

The procedure for developing pictorials was somewhat different from that in experiment 1. Thirty-one undergraduate student volunteers participated in pictorial comprehension tests that included the matching procedure used in experiment 1 and a procedure in which participants were asked to describe what each pictorial meant. Results of the pretest indicated that some of the pictorials were not well understood. The artist therefore was asked to refine the pictorials, and their comprehensibility was tested again with 46 undergraduate student volunteers. The pictorials judged most representative of particular knowledge categories were used on the poster.

Verbal Content

The verbal content of the poster in experiment 1 was examined in detail, and only information that was not well known to the participants (according to pretest scores on the knowledge test) was retained. Additional facts and new categories were introduced in place of the deleted information and minor changes were made to the information that was retained. As a result, two new categories were added to the poster (health consequences and sexual performance) and the general performance category was deleted.

Dependent Measures

A 25-item alcohol knowledge survey was developed to determine participants' knowledge of information contained on the poster. The survey consisted of fill-in-the-blank items that were used to assess participants' recall of information presented in each of the five knowledge categories. A problem-solving question was also included to determine the participants' ability to use a BAC nomogram.

Design and Procedure

As in experiment 1, a Solomon four-group design was used with random assignment of each fraternity to one of the following conditions: PNP (n = 20), PIP (n = 20), NIP (n = 22), or NNP (n = 22). Two social fraternities were assigned randomly to either the PNP or PIP condition, and one each to the NIP and NNP conditions. Most aspects of the procedure were identical to those in experiment 1, with a few exceptions. First, in contrast to experiment 1, we were able to track individual participants by means of fictitious identification codes that each participant provided. This procedure ensured confidentiality and allowed for the use of a within-subjects design for participants in the PIP and PNP conditions. Second, the warning posters remained in place for one week, whereas in experiment 1 they remained in place for two weeks. Third, we did not obtain a measure of BAC nomogram performance on the pretest, thus eliminating any possibility of contamination of posttest BAC performance due to the pretest.

Results

The mean proportion-correct scores for overall knowledge, each of the five knowledge categories, and BAC nomogram performance are reported in Table 2. Analyses parallel those used in experiment 1, with the exception that within-subjects analyses were conducted on all pretest-posttest differences. Analysis of overall knowledge for the PIP and PNP groups in a 2 (age: under age 21, age 21 and older) × 2 (intervention: poster, no poster) × 2 (time of testing: pretest, posttest) ANOVA indicated no significant main effect for age and no interactions with age ($p > .05$). Therefore, we collapsed the data across age for all subsequent analyses.

Equivalence of Conditions

A one-way between-subjects ANOVA for overall knowledge scores on the pretest of the PNP and PIP groups and the posttest of the NNP group indicated no significant difference among the means ($p > .05$). Thus, groups were equiv-

Figure 2. Alcohol Warning Poster Used in Experiment 2[a]

CAUTION

Death & Injury

- Alcohol kills 97,500 people in the United States each year.
- More than 44% of alcohol-related traffic crashes involve drivers under age 24.
- More than 50% of all traffic deaths are caused by alcohol.
- As many as 90% of all the fatally-injured drinking drivers are male.
- Nearly 75% of all drownings are alcohol-related.
- More than 50% of fatal falls are due to the effects of alcohol.
- 90% of all fraternity/sorority hazing deaths are alcohol-related.

Sexual Performance

- At BACs between .05 and .10 your sexual arousal is greatly reduced.
- At BACs above .10 your ability to have an orgasm will be inhibited, or eliminated.
- Alcohol impairment greatly increases your chances of engaging in "regrettable sex" - sexual encounters that you later regret.
- Alcohol impairment make it less likely that you'll practice "safe-sex," increasing your chances of getting sexually transmitted diseases such as AIDS.
- Heavy alcohol use by men reduces testosterone levels and can result in shrinking of the testicles and impotence.

Health Consequences

- Adverse health consequences result from as few as three daily drinks.
- Alcohol impedes functioning of immune system cells, increasing your susceptibility to infectious diseases and cancer.
- Alcohol increases blood pressure and cholesterol level.
- Alcohol leaches calcium from your bones and can produce anemia.
- Long-term drinking increases your risk of developing testicular cancer--the largest killer of men 15 to 40 years of age.
- Alcohol alters the functioning of brain cells--gradually impairing memory, judgment, and other important cognitive abilities.

Liability

- Financial law suits stemming from alcohol-related accidents can be brought against you, your parents, your fraternity, and the Institute.

In New York State:

- penalties for driving while alcohol impaired (DWAI, BAC $\geq$ .05) range from 90-days to 6-months suspension of your license, 15 to 90 days in prison, and from a $250 to $1500 fine; and
- penalties for driving while intoxicated (DWI, BAC $\geq$ .10) range from 6-month to 1-year revocation of your license, 1 to 4 years in prison, and a $350 to $5000 fine.
- Refusing to take a Blood Alcohol Concentration test will result in a 1 year revocation of your driver's license (or until age 21, which ever is greater) and a $250 fine.

Alcohol Consumption Facts

- Heavy drinking (three or more drinks in one sitting) blocks the absorption of essential nutrients and contributes to malnutrition
- 70% of heavy drinkers have deficits in problem solving, abstract thinking, motor coordination, and memory.
- Cognitive impairment stemming from heavy social drinking is irreversible and similar to premature aging.
- Your body processes alcohol at a constant rate of .50 oz of alcohol per 90 minutes.
- The following measured amounts of beverage contain approximately 0.5 oz. of alcohol:

  12 oz. of regular beer or 4 oz. of wine or a 1 oz. "shot" of 100 proof spirits.

Do You Know Where You Stand? Know Your Limit

Instructions: Count up all the drinks you've had. Then, subtract 1 drink for every 2 hours that have elapsed since you began drinking. Now, locate your approximate BAC on the chart below. Remember, this is only an estimate and does not take into account other important factors like those mentioned above.

	Number of Drinks											
		DWAI		DWI								
Body Weight	1	2	3	4	5	6	7	8	9	10	11	12
100	.038	.075	.113	.150	.188	.225	.263	.300	.338	.375	.413	.450
120	.031	.063	.094	.125	.156	.188	.219	.250	.281	.313	.344	.375
140	.027	.054	.080	.107	.134	.161	.188	.214	.241	.268	.295	.321
160	.023	.047	.070	.094	.117	.141	.164	.188	.211	.234	.258	.281
180	.021	.042	.063	.083	.104	.125	.146	.167	.188	.208	.229	.250
200	.019	.038	.056	.075	.094	.113	.131	.150	.169	.188	.206	.225
220	.017	.034	.051	.068	.085	.102	.119	.136	.153	.170	.188	.205
240	.016	.031	.047	.063	.078	.094	.109	.125	.141	.156	.172	.188

[a]Actual dimensions were 30.5 by 45.7 cm. The areas around the signal word and pictorials were in bright fluorescent yellow.

Table 2. Overall Knowledge, Knowledge Category, and BAC Nomogram Performance Means and Standard Errors for Each Experimental Condition in Experiment 2

	Experimental Condition							
	PNP		PIP		NNP		NIP	
Outcome Measure	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Overall knowledge	.18	.17	.20	.25	—	.18	—	.24
	.02	.01	.01	.02		.01		.02
Death and injury	.12	.16	.14	.21	—	.16	—	.21
	.03	.04	.03	.04		.04		.04
Sexual performance	.29	.26	.29	.37	—	.31	—	.36
	.03	.03	.03	.04		.03		.04
Health consequences	.08	.04	.10	.14	—	.05	—	.09
	.02	.01	.03	.03		.02		.02
Legal liability	.17	.16	.19	.22	—	.19	—	.23
	.03	.02	.02	.03		.02		.02
Physiological effects	.39	.36	.39	.49	—	.28	—	.49
	.04	.04	.04	.05		.04		.05
Correct use of BAC nomogram	—	.00	—	.55	—	.05	—	.41
		.00		.11		.05		.11

alent in overall knowledge prior to the intervention and across time when no intervention was present. Further analyses to determine the equivalence of groups were conducted on posttest knowledge and BAC nomogram performance scores. These analyses indicated no significant differences between posttest scores for either the no poster groups or the poster groups ($ps > .05$).

Analysis of Pretest to Posttest Changes: Knowledge of Alcohol-Related Information

Separate 2 (intervention: poster, no poster) × 2 (time of testing: pretest, posttest) mixed-model ANOVAs, with intervention as the between-subjects factor and time of testing as the within-subjects factor, were carried out for overall knowledge and each of the knowledge categories for the PIP and PNP groups. Results for overall knowledge indicated a significant main effect of intervention ($F_{1,38} = 7.22$, $p < .05$) and an intervention by time of testing interaction ($F_{1,38} = 5.69$, $p < .05$). Simple effects analysis indicated that overall knowledge among participants in the poster condition increased significantly from pretest (M = .20) to posttest (M = .25) ($p < .05$), whereas there was no significant increase in knowledge for participants in the no poster condition. We found no difference in participants' pretest knowledge across intervention conditions ($ps > .05$), but participants' posttest knowledge was significantly greater in the poster condition (M = .25) than in the no poster condition (M = .17) ($p < .05$).

As shown in Table 2, participants in the poster condition showed an increase in knowledge for each of the five knowledge categories, whereas knowledge of participants in the no poster condition did not change. Separate analysis of each knowledge category indicated one main effect of intervention: knowledge of the health consequences of alcohol abuse ($F_{1,38} = 6.66$, $p < .05$). No significant main effects of time of testing were shown for any of the individual knowledge categories ($ps > .05$). The only significant intervention by time of testing interaction was for alcohol's effects on sexual performance ($F_{1,38} = 5.38$, $p < .05$). Simple effects analysis of the sexual performance category indicated that the knowledge of participants in the poster condition increased significantly from pretest (M = .29) to posttest (M = .37) ($p < .05$), whereas there was no change in knowledge for participants in the no poster condition. Simple effects analysis also showed that participants' posttest knowledge was significantly greater in the poster condition (M = .37) than in the no poster condition (M = .26) ($p < .05$), but there was no difference in their pretest knowledge.

More in-depth analyses examined knowledge for each of the five sexual performance facts. Only one showed a significant effect, indicating an intervention by time of testing interaction for alcohol's effect on orgasm ($F_{1,38} = 4.75$, $p < .05$). Simple effects analysis indicated that the knowledge of participants in the poster condition increased significantly from pretest (M = .00) to posttest (M = .20) ($p < .05$), but there was no increase in knowledge for participants in the no poster condition. Participants' posttest knowledge was significantly greater in the poster condition (M = .20) than in the no poster condition (M = .00) ($p < .05$), but there was no difference in their pretest knowledge.

Analysis of Posttest Scores: Knowledge of Alcohol-Related Information

Separate 2 (intervention: poster, no poster) × 2 (pretest: present, absent) between-subjects ANOVAs were performed on the Posttest scores for overall knowledge and each of the knowledge categories. For overall knowledge, we found a significant main effect of intervention, ($F_{1,80} = 18.58$, $p <$

.001), indicating that participants exposed to the poster had greater overall knowledge of alcohol-related information (M = .24) than participants not exposed to the poster (M = .17). No other effects for overall knowledge were significant.

Results of analyses of each knowledge category indicated that none of the main effects of pretesting and none of the intervention by pretest interactions were significant. However, significant main effects of intervention were shown for knowledge of alcohol's effects on sexual performance ($F_{1,80} = 4.68$, $p < .05$), the health consequences of alcohol abuse ($F_{1,80} = 10.24$, $p < .01$), alcohol-related legal liability and penalties ($F_{1,80} = 5.47$, $p < .05$), and the physiological effects of alcohol intoxication ($F_{1,80} = 12.68$, $p < .001$). In comparison with participants in the no poster conditions, participants in the poster conditions were more knowledgeable about alcohol's effects on sexual performance (M = .36 vs. M = .29), the health consequences of alcohol abuse (M = .11 vs. M = .05), alcohol-related liabilities and penalties (M = .23 vs. M = .05), and the physiological effects of alcohol consumption (M = .49 vs. M = .32).

Subsequent analyses were performed on the facts from categories demonstrating a significant main effect of intervention. Results indicated that for knowledge of sexual performance, participants in the poster conditions were more knowledgeable than those in the no poster conditions about alcohol's effect on arousal (M = .67 vs. M = .43) and orgasm (M = .21 vs. M = .07). For knowledge of the health consequences of alcohol, participants in the poster conditions were more knowledgeable about the number of drinks per day that cause adverse health effects (M = .50) than participants in the no poster conditions (M = .14). For knowledge of legal liability and penalties, participants in the poster conditions were more knowledgeable about the penalties for refusing a blood alcohol test (M = .71) than participants in the no poster conditions (M = .38). For knowledge of the physiological effects of alcohol, participants in the poster conditions were more knowledgeable than those in the no poster conditions of the amount of alcohol in a 1.25-oz drink of 80 proof spirits (M = .83 vs. M = .57) and a 4-oz drink of wine (M = .38 vs. M = .10).

Analysis of Posttest Scores: Use of a BAC Nomogram

Results showed a significant main effect of Intervention ($F_{1,80} = 4.37$, $p < .001$), indicating that participants exposed to the poster performed better on the BAC nomogram problem (M = .48) than participants not exposed to the poster (M = .02). No other effect was significant.

Discussion

The results of experiment 2 show that the redesigned warning poster increased participants' knowledge of alcohol facts and hazards. Groups exposed to the warning poster received a mean posttest score of .24, whereas groups not exposed to the poster received a mean posttest score of .17, a difference of 41%. Moreover, comparison of these groups' posttest scores for each of the knowledge categories reveals that groups exposed to the warning poster had significantly higher posttest scores in five of the six knowledge categories (i.e., only death and injury was not significant). This pattern of results was confirmed by analysis of pretest-posttest changes among the PIP and PNP groups.

Noteworthy is the fact that the material selected for inclusion on the poster used in this study was not well known. Though pretest knowledge of information for each of the individual categories varied, with mean scores ranging from about .08 for the health consequences category to .35 for the physiological effects category, the overall mean pretest score across all groups was .15.

General Discussion

The results suggest that, consistent with previous research, posters can be an effective means of communicating important health-related information, including the risks and hazards of alcohol consumption. A primary aim of our two experiments was to design a posted warning effective in conveying important information to a specific target group, college students. Because the design and content of the current government alcohol warning are not specific to the needs of this group, well-designed posted warnings may be one alternative means for conveying alcohol-related information to them.

An important outcome of our study is the recognition that more research is needed to develop posted warnings that are optimal for specific target populations. The redesigned poster used for experiment 2 clearly contained more novel information than the poster used in experiment 1, and in content areas that, at least by the reports of students, were of great interest (e.g., sexual performance). However, the relatively small increases in performance after the intervention indicate great room for improvement. Future research in this area should systematically examine various features of posters to maximize their effectiveness, including the information content and the way it is presented on the poster (e.g., size, color, contrast). Moreover, alcohol warnings like the two posters examined in our study should be designed for use with other populations who are at risk from alcohol consumption, including pregnant women and groups of individuals predisposed to alcohol-related health problems (e.g., alcoholism).

Informal analysis of the types of questions for which performance increased most after the poster intervention revealed a pattern of results that may be instructive for the design of future posters. Specifically, the questions showing greatest improvement after exposure to the poster seemed to be those pertaining to short-term consequences (e.g., the effects of alcohol on orgasm, legal consequences of refusing a chemical test, the use of a BAC nomogram to predict one's level of impairment, and the rate at which the body processes alcohol) rather than long-term consequences (e.g., cirrhosis of the liver, increased susceptibility to infectious diseases and cancer). In other words, the students in our study appeared to pay most attention to information that had the greatest potential for affecting their immediate future. This finding is consistent with research suggesting that young adults generally do not believe they are personally susceptible to alcohol-related consequences, especially for long-term consequences [Portnoy 1980; Smith and McCauley 1991]. Hence, the participants may have felt that

facts about long-term alcohol-related health consequences were not relevant to themselves. In future revisions of the poster, it may be wise to present information that emphasizes immediate contingencies in a manner consistent with the needs and interests of specific target groups.

One question about the use of interventions such as the warning posters used in our experiments is whether they have the potential to change behavior and not simply knowledge. We attempted to explore this possibility at a social fraternity that had as a policy a "bar bill procedure" detailing individual members' daily consumption of beer in terms of number of 12-oz cans consumed per day. The warning poster was placed at several tactical locations throughout the fraternity house, including above the bathroom urinal, inside the door of the bathroom stall, and on the refrigerator from which members obtained their beer. The results of this exploratory study showed that beer consumption decreased significantly, especially among "high risk" drinkers, those who consumed five or more drinks on one or more occasions [Kalsher, Wogalter, and Clarke 1991]. Unfortunately, in the absence of a more powerful experimental design (i.e., only an A-B design was possible), these results are preliminary and require replication with appropriate controls. Even so, these findings suggest that well-designed posters may be a useful supplement to the current government-mandated alcohol warning.

One aspect of our study that warrants mention is the "passive" nature of the intervention. Specifically, nothing other than the posted warnings was used to disseminate alcohol-related information. Larger effects may have been realized had the poster intervention been preceded by an announcement in the school newspaper or a meeting to inform and actively discuss with the study participants the relevance to them of the information contained on the poster. However, some "active" communication might have taken place, given that fraternities are social groups in which considerable communication occurs between members. Thus, even if only a few participants in the intervention groups actually read the poster, they may have then communicated the information to other fraternity members. Future studies should capitalize on this possibility by arranging focus groups or other kinds of interactive sessions to actively inform participants of the poster and the potential utility of disseminating the information on a social basis. Such an approach may enhance the effectiveness of alcohol warning posters.

Perhaps the most important contribution of our study is the finding of a cost-effective means for communicating alcohol facts and hazards to specific target audiences. It is noteworthy that the 28 posters used in experiments 1 and 2 cost less than $150 to make (excluding the time required to construct them). Further research in this area could extend our findings by creating warning posters that target other high risk groups, such as Native Americans or women of childbearing age. Given the results of our study, warning posters designed for particular high risk target audiences appear to be an efficient means of enhancing knowledge of alcohol facts and hazards in ways the current container label cannot.

Our experiments show that posted warnings can significantly increase college students' knowledge of alcohol-related facts and hazards. The importance of these results cannot be overstated given that college-age persons are under-represented in terms of their proportion of the driving population, but over-represented in alcohol-related traffic crashes and other accident types involving alcohol (e.g., drownings). Besides making the information relevant to specific target groups, future studies should concentrate on determining optimal placement of the posters [Wogalter et al. 1987; Wogalter, Kalsher, and Racicot 1992] and establishing the appropriate time period for displaying the poster information. In our study, the posters were placed in bathrooms above urinals and on the inside door of bathroom stalls to maximize the probability that fraternity members would notice and read them. In many situations, such "ideal" placement sites may not be available. Moreover, posted warnings may have to compete with other posted material, which may diminish their effectiveness [Wogalter, Kalsher, and Racicot, in press].

Though the posters used in experiments 1 and 2 were hand-made and therefore inexpensive, some applications may require that posters be professionally produced, especially those constructed to complement televised alcohol warnings and magazine ads. Another important consideration in the use of posters is that the information presented on them, as well as the format, may not have a long period of effectiveness. Hence, it may be necessary to continually update the information content and change the format characteristics on posted warnings. Indeed, it may be advisable to develop "rotating" messages in advance of their implementation to ensure that the information conveyed is fresh, thereby increasing the chances that the poster warning will be examined in the future.

Finally, our findings have important public policy implications. Posted placards containing a large amount of information designed for a specific target group can be effective in changing the group's knowledge of the potentially harmful substance of concern, and perhaps their behavior. In our study, the primary target group was college students and we designed the poster to reflect information that would be relevant to that group. Additional research that systematically manipulates various features of the poster, including informational content and format characteristics (e.g., font, size, message length, color) is needed to maximize the impact of posted warnings on specific target groups. However, impending legislation calling for warning messages in print and broadcast advertisements for alcoholic beverages [Hilton 1992] suggests another major role of posters as a means of transmitting important alcohol-related information. Research by Smith [1990] indicates that the effects of televised alcohol warnings are modest, perhaps because the expense of television air time limits the amount of information that can be conveyed or perhaps because television audiences are in a "low drive" state that limits the amount of information they acquire. Thus, an important potential role of posted warnings is to complement and extend information presented in television, radio, or magazine advertisements.

A more direct policy implication is that one can target information campaigns to a wide variety of groups. In other words, the specific content of the posted materials may de-

pend on the target audience to whom the warnings are directed. For example, a recent study by Long and Gelfand [1992] found that practicing nurses were deficient in their knowledge of the physiological and psychosocial components of alcohol abuse and alcoholism, despite the fact that alcohol-related problems were present in many of the patients under their care. Posters could be constructed to improve nurses ability to cope with the alcohol-related problems of their patients. Clearly, though we used a specific information content to affect knowledge of a particular target group, the general principle—tailor educational strategies to meet the needs of individuals—can be applied to the development of effective interventions suitable in a variety of situations and across groups with different needs.

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