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# HANDBOOK OF WARNINGS

EDITED BY

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To my parents, Laura and Ralph  
and  
to my sister and brother, Rosanne and Kevin  
and  
to all of my family, friends, colleagues, and students.

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## ALCOHOL AND TOBACCO WARNINGS

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### ABSTRACT

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This chapter surveys warnings on alcohol and tobacco products. Tobacco warnings have a longer history and are required in more countries than alcohol warnings. A recent World Health Organization treaty requiring tobacco warnings will further increase the number of countries with tobacco warnings. The consolidated human information processing model was used to organize the review of published research on the effects of the alcohol and tobacco warnings. Results of the U.S. alcohol warning are described because of a paucity of research on alcohol warnings from other countries. Overall, there is evidence that alcohol warnings are noticed and remembered, but there is not much evidence for an effect on alcohol consumption or related behaviors. Results of Australian, Canadian, and U.S. tobacco warnings provide the bulk of research reviewed on tobacco warnings. There is evidence of substantial effects of tobacco warnings. In particular, recent research on the Canadian warning suggests that it may reduce smoking and increase quit attempts. The Canadian warning has several important characteristics suggested by human factors research, such as larger size and graphic images. Future research should clarify the magnitude and scope of tobacco warning effects that may suggest ways to improve alcohol and tobacco warnings.

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### INTRODUCTION

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Since smoking might injure your health, let's be careful not to smoke too much (English translation of the current Japanese tobacco warning label, Moffett, 2003).

### The Problem

The polite Japanese warning at the opening of this chapter contrasts with the estimated 10,000 tobacco-related deaths each day worldwide (Aftab, Kolben, & Lurie, 1999). The health, economic, and social costs of tobacco use are well documented (Bartecchi, MacKenzie, & Schrier, 1994). The health and economic costs of alcohol use are also substantial, owing to alcohol's involvement in cancer, homicide, drowning, automobile accidents, and accidents at work (Harwood, Fountain, & Livermore, 1998; Rice, 1999; U.S. Department of Health and Human Services (DHHS; 1986). Each year in the United States, approximately 20,000 traffic fatalities and a quarter of a million traffic injuries involve alcohol (DHHS, 1988). Given these substantial health and economic costs, a variety of alcohol and tobacco prevention strategies have been adopted, including warnings on alcohol and tobacco products.

Alcohol and tobacco warning labels represent low-cost interventions that might be effective by themselves or as cues to other prevention activities, such as media campaigns. The warnings provide information and do not directly place constraints on behavior. Alcohol (Greenfield, 1997; Kaskutas, 1993a) and tobacco (Commonwealth of Australia, 2001) warnings have considerable public support, and most citizens view the risks mentioned in the warning as serious public health problems. Because the warnings are on all alcoholic beverage and tobacco containers, users are repeatedly exposed to them. Furthermore, the potential exposure to the warnings increase as use increases, thereby potentially warning the group most at risk.

## Alcohol Warnings

A 1997 survey (International Center for Alcohol Policies, 1997) reported that nine countries have national legislation requiring health warning labels on alcohol containers (Brazil, Colombia, Costa Rica, Ecuador, Honduras, Mexico, South Korea, United States, and Zimbabwe), three countries have mandatory warnings on advertisements (France, Panama, and Paraguay), and another eight countries are considering such legislation (Australia, Canada, France, Japan, New Zealand, Taiwan, Thailand, and South Africa). Ireland's Ministry of Health is currently considering compulsory health warnings ("Moderation Urged," 2003). Most of the nine countries with an alcohol warning had a general warning about the hazards of excessive drinking. The United States and South Korea had warnings that included more specific risks.

In the United States, warning labels on alcohol containers were first proposed as early as 1945 in Massachusetts (Haggard, 1945); federal warnings were proposed in 1967 and then several times since 1978. In 1988, U.S. legislation was passed requiring the following warning label on alcoholic beverage containers starting November 18, 1989 (Alcoholic 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. (p. 6)

In 1999, several members of Congress, public health organizations, and consumer organizations petitioned the Bureau of Alcohol, Tobacco, and Firearms to make changes to increase the noticeability of the warning, but these changes have not been approved to date (U.S. Department of the Treasury 2001).

## Tobacco Warnings

Warnings on tobacco packages were mandated in the United States following the landmark Surgeon General's report on smoking (DHHS, 1964) and the 1962 U.K. report of the Royal College of Physicians (1962) documenting the risks of smoking. In the United Kingdom, voluntary warnings on cigarette packaging started in 1971. The first U.S. cigarette warning label, "Caution: Cigarette smoking may be hazardous to your health," was required on cigarette packages starting in January 1966. Later, the warning included changes to the signal word to convey a higher level of hazard, removing the qualifier for the risk (may) and attributing the warning to a knowledgeable and respected authority figure, the Surgeon General. Beginning in November 1970, the warning read, "A Warning: The Surgeon General has determined that cigarette smoking is dangerous to your health." By October 1972, the 1970 warning was also required on print ads. The cigarette warning label was again modified with new legislation to include more specific risks in addition to the general health hazard and to improve the signal word noticeability with capital letters. Starting in October 1985, one

of four different, rotating warnings was displayed on cigarette packages:

- (a) SURGEON GENERAL'S WARNING: Smoking causes lung cancer, heart disease, emphysema, and may complicate pregnancy,
- (b) SURGEON GENERAL'S WARNING: Smoking by pregnant women may result in fetal injury, premature birth, and low birth weight,
- (c) SURGEON GENERAL'S WARNING: Cigarette smoke contains carbon monoxide, and
- (d) SURGEON GENERAL'S WARNING: Quitting smoking now greatly reduces serious risks to your health.

Smokeless tobacco warnings were required in 1989 when one of the following three warnings was required on smokeless tobacco packages, "WARNING: This product may cause mouth cancer," "WARNING: This product may cause gum disease and tooth loss," and "WARNING: This product is not a safe alternative to cigarettes." On print advertisements, the smokeless tobacco warning was placed inside a circle with an arrow pointed to the warning.

In Australia, "Warning: Smoking is a health hazard" was required to appear in 1973. In 1987, a set of explicit rotating warnings were required, and in 1995 more prominent warnings occupying the flap top of a cigarette pack and 25% of the rear of the back were introduced, along with information on how to quit smoking. In Canada, warnings were required to be more legible in 1989; larger warnings written in French and English were required starting in 1994 (Mahood, 1995), and picture warnings were required in December, 2000. Most of the published research on tobacco warnings described in this chapter evaluated the Australian, Canadian, or U.S. warnings.

A recent investigation by the World Health Organization (2003) reported that 141 countries had some kind of tobacco warning (Mackay & Eriksen, 2002; World Bank, 1999). A study of tobacco warnings in 45 countries showed that 40 had mandatory warnings, 3 had voluntary warnings, and 2 had no warnings (Aftab et al., 1999). Of those countries with tobacco warnings, most had a general, text warning. The most common risk described in the warnings was heart disease, and the least common risk was addiction. Warnings in Brazil, Canada, and Iceland (Blondal & Magnusson, 1985) include pictorial information in the warnings. The warnings in Brazil and Canada display graphic images accompanying a textual warning. Warnings in developed countries tended to be larger and more frequently placed on the front than on the side of the cigarette package (Joossens, 2000). The European Union (EU) requires each member country to institute its own laws requiring warnings that take up at least 30% of the front and 40% of the back of the package (Portillo & Antoñanzas, 2002). In response to the positive results of the Canadian picture warning, the EU will set up a library of picture warnings that EU countries may use on a voluntary basis. Australia is also considering new health warnings containing images (Commonwealth of Australia, 2001). Sample warnings from Australia, Canada, and the United States are shown in Fig. 54.1.

Japan is considering making its warning label stronger, and legislation to make U.S. warnings more graphic, like Canadian

warnings, was proposed in 1997 (Krugman, Fox, & Fischer, 1999) and is now being considered by the Congressional Task Force on Tobacco and Health (Davidson, 2002). Thailand will introduce picture warnings in 2005 (Fong, Hammond, Borland, Hastings, & Cummings, 2004). In May 2003, after a 3-year negotiation process, 192 member states of the World Health Organization adopted the Framework Convention on Tobacco Control, the first-ever international treaty on health (World Health Organization, 2003). Among the tobacco control policies listed in that treaty are specifications that warnings occupy at least 30% of the principal surfaces and that they be clear, visible, and legible, with provisions for multiple rotating warnings. In addition, member states are encouraged (but not required) to include graphic or pictorial elements. As a result of this treaty, many countries will either be enhancing their tobacco warnings or requiring them for the first time. Warning labels for tobacco, and in some cases alcohol, are becoming more commonly adopted and more visible or graphic worldwide.

### Goals of Alcohol and Tobacco Warning Labels

From a human factors perspective, warnings are considered for adoption after attempting the redesign of a product to remove the risks and after providing guards to protect the user (see Wogalter, chap. 1, this volume). Examples of the design approach are alcohol-free beer and attempts to remove carcinogenic agents from tobacco smoke, but these new products have not substantially altered alcohol and tobacco consumption. Examples of protection guards for alcohol and tobacco products include limiting their availability (e.g., locations or age limits) and vehicle ignition interlock devices that do not allow people to drive their cars if there is alcohol in their breath.

Given that the risks of tobacco and alcohol use cannot be fully designed out of the product and that few guards are available, warnings are used to inform persons of the risks associated with the product while allowing persons to continue choosing their consumption. The tobacco warning appears on product

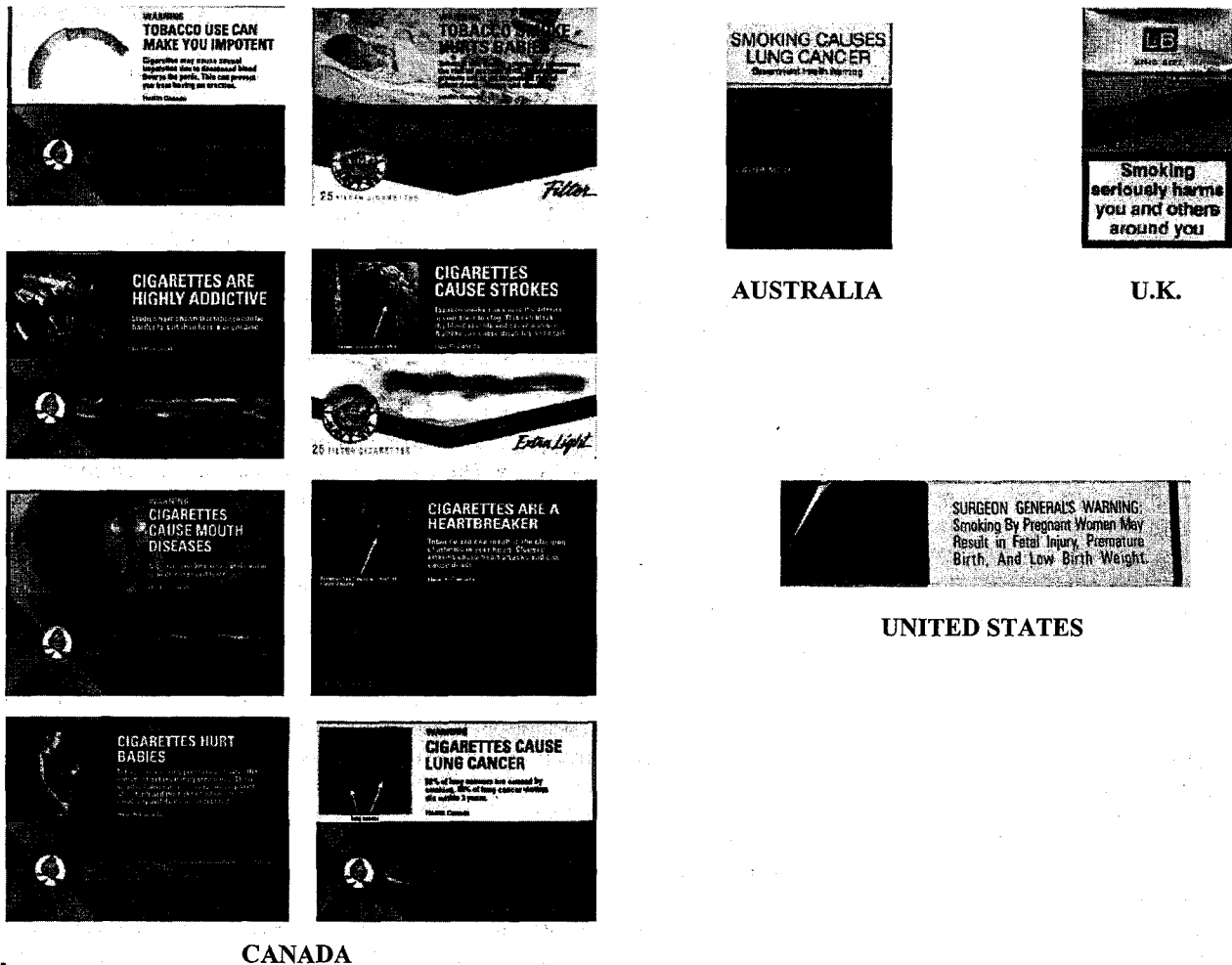


FIGURE 54.1. Examples of U.S., Australian, and Canadian tobacco warnings.

packaging and advertisements in the United States. The alcohol warning appears on the alcohol container, but not in advertisements, and a warning of the risk of birth defects is shown in posters at points of sale in some states.

From a legal perspective, warnings are viewed as a cost-effective strategy to inform and instruct consumers in the proper use of the product (Lehto & Miller, 1986). If manufacturers satisfy their "duty to warn," they receive some limitation of liability (Andreas, 1988; Dukes, 1989; Khoury, 1989; Schwartz & Driver, 1983; Ursic, 1985; see Part X, this volume). The text of tobacco and alcohol warning label laws states their purpose as informing and reminding the public about the risks of use and reducing uncertainty and misperceptions about the possible consequences of use. Changing behavior is not explicitly mentioned in the text of the laws. However, changing behavior is often cited as the ultimate criterion for warning effectiveness (Peters, 1984). Whether warnings change behavior is controversial (Cox, Wogalter, Stokes, & Tipton-Murff, 1997; Lehto & Miller, 1988; McCarthy, Finnegan, Krumm-Scott, & McCarthy, 1984), and the beneficial effects of the tobacco and alcohol warning label also have been questioned (Engs, 1989; Lipson & Wester, 1990; Seegmiller, Carey, & Fineman, 1990; West, 1990; Willhite & Book, 1990). A meta-analysis including 15 experimental studies of on-product warnings indicated that, under the appropriate circumstances, warnings can sometimes increase safe behavior, but the amount of variability in warning compliance is large (Cox et al., 1997). Nevertheless, the ultimate public health criteria for the effectiveness of alcohol and tobacco warning labels are changes in the incidence and prevalence of tobacco and alcohol-related problems (Krugman et al., 1999).

Finally, there is an important difference in the intended function of the alcohol and tobacco warning labels. There does not appear to be a safe level of tobacco use making abstinence a warning goal. There is evidence, however, that moderate amounts of alcoholic consumption may accrue health benefits, so the warning focuses on irresponsible and problematic alcohol consumption. In this regard, the warning for alcohol is similar to most product warnings that focus on preventing incorrect or inappropriate use of a product.

### Criticisms of Alcohol and Tobacco Warning Labels

Alcohol and tobacco warnings have been criticized for several reasons. One of these criticisms is that persons are already aware of the risks of alcohol and tobacco use, and too many environmental warnings may divert attention from critical warnings (Driver, 1987; Lehto & Miller, 1986; Twerski, Weinstein, Donaher, & Piehler, 1976; Weinstein, Twerski, Piehler, & Donaher, 1978). This view acknowledges that warnings do not occur in isolation and presumes that excessive warnings reduce compliance to any one warning. The many warnings in our environment must compete with each other and with other stimuli for attention because individuals may have limited attentional resources (Stewart & Martin, 1994). Similar points are made by Driver (1987) and Kantowitz and Sorokin (1983), who have argued that warning labels should be reserved for only those products for which it can be determined that warning labels

will be an effective means of communication and that excessive warnings may be as bad as insufficient warnings.

A process by which overwarning may occur is suggested by the psychological processes operating when persons are warned of a threat but do not experience any immediate negative consequences (MacKinnon, Bryan, & Barr, 1993). If threats are made without any negative consequences, there may be a loss in credibility of the source of the warning or a decrease in the perceived credibility of the warning system, and protective action is less likely to be taken (Breznitz, 1984). Typically, alcohol and tobacco users see the warnings repeatedly, yet never experience any immediate negative outcomes with the product. Most persons have, at least indirectly, experienced some negative consequences of alcohol and cigarette use, but not each time alcohol is consumed or a cigarette is smoked. Similarly, the familiarity effect (Goldhaber & deTurck, 1988; Laughery & Brelsford, 1991), in which persons perceive products as less harmful and are less likely to read warnings as they become more familiar with them, may be present for alcohol and tobacco warnings. An alcohol user may be warned about negative consequences for a drug that actually produces feelings of euphoria, which may exacerbate the familiarity effect. A similar effect may be present for pharmacological effects of nicotine, and serious consequences may not appear for many years after repeatedly using tobacco.

Repeated exposure to warnings may also have beneficial effects whereby moderate repetition leads to more understanding of the meaning and implications of the warning (Cacioppo & Petty, 1979, 1989). During high levels of message repetition, however, psychological reactance may occur, leading to counterproductive effects of warnings. Hyland and Birrell (1979) found evidence for reactance in a study in which housewives rated 25 tobacco advertisements that either had or did not have warnings. After about 15 advertisements, the results suggested that persons exposed to the warning reported a greater desire to smoke than persons not exposed to the warning, although methodological problems limit clear conclusions from this study. The warnings may also induce reactance if it is perceived that the warnings take freedom away from users. Concrete evidence of this reactance effect is that smokers purchase new warning stickers produced to place over existing warnings, for example, the warning, "Passive smokers should buy their own" is placed over the existing warning (Graham, 1998). On the other hand, the high levels of public acceptance of warnings (Greenfield, 1997) suggested that psychological reactance may not be an important phenomenon for alcohol and tobacco warnings. It is also possible that age may moderate a psychological reactance effect, if it exists.

### The Consolidated-Human Information Processing Model

As described in chapters 7 and 8 (this volume), several theories provide guidance for how the alcohol and tobacco warning labels may influence behavior. These theories predict that ultimate change in tobacco and alcohol use may result from small changes over a long period, and immediate effects on behavior are unlikely. Recently, Wogalter, DeJoy, and Laughery

(1999) provided a consolidated communication-human information processing (C-HIP) model that combines McGuire's (1980) communication model and principles of information processing. There are three major parts to the model: source, channel, and receiver. The receiver section is divided into five parts corresponding to the most typical sequence of warning effects: (a) Attention and Noticeability, (b) Memory and Comprehension, (c) Attitudes and Beliefs, (d) Motivation, and (e) Behavior. The C-HIP model clarifies the sequence of potential effects of a warning. For a warning to be effective, it must be noticed and understood, leading to attitude change, motivation to comply with the warning, and finally behavior change. The effects of warning labels on actual behavior are small because each of the successive steps must be passed for the label to change behavior, although this model does allow for skipping parts of the sequence. The C-HIP model is used to organize research on alcohol and tobacco warnings in this chapter.

### Studies Included in the Review

The following review focuses on research published in English on alcohol container and tobacco package warning labels. In addition, relevant alcohol and tobacco research on warning posters and warnings on advertisements are described. Reviews by Agostinelli and Grube (2002), Andrews (1995), Hilton (1993), MacKinnon (1995), MacKinnon and Nohre (2000), and Stockley (2001) described the initial U.S. alcohol warning label research. The researchers came to similar conclusions based on the evidence: The public was aware of the existence of an alcohol warning, had seen the warning, and could typically remember the risks described in the warning; however, perceptions of risk and the behaviors targeted by the warning generally had not changed.

In an overview of strategies to control tobacco use, Cummings (2002) concluded that many studies of tobacco warnings have methodological limitations but there was some preliminary evidence for beneficial effects for Australian and Canadian warnings. Krugman et al. (1999) also noted the paucity of tobacco warning research and argued that tobacco warnings have failed as a public health strategy, at least in part, because the warning was negotiated rather than developed based on communication strategies.

This chapter supplements these earlier reviews of alcohol and tobacco warnings with more recent research and includes more tobacco warning research. The studies were obtained by contacting authors of previous warning label articles and through literature and Internet searches. Priority was given to published and in-press articles from a wide range of journals reflecting authors from a variety of disciplines, including human factors, law, marketing, psychology, public health, and public policy. The various disciplines contribute slightly different perspectives and methodologies. These differences combine to create a richer understanding of substantive issues, and the methodological differences provide a more solid evidence base.

Research on the alcohol warning label is described first, followed by research on the tobacco warning label. Within each

drug, the order of the research studies described is based on the stages in the consolidated C-HIP model.

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## ALCOHOL WARNING LABEL RESEARCH

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This section reviews only U.S. alcohol warning label research because of the lack of published research on alcohol warnings from other countries. The U.S. alcohol warning label has been investigated with a range of experimental and quasi-experimental designs, including laboratory experiments, telephone surveys of adults, and school surveys of students. The U.S. National Institute on Alcoholism and Alcohol Abuse (1989) funded much of the alcohol warning label research, which increased the number and quality of alcohol warning label studies.

### Attention and Noticeability

A series of laboratory experiments with adult participants, recruited by telephone to reflect population demographic groups, found that the current alcohol warning was not particularly noticeable, primarily because the warning did not stand out from its background (Laughery, Young, Vaubel, & Brelsford, 1993). In these studies, participants examined alcohol containers, some of which had warnings, and the time to notice the warning was measured. Several design aspects improved the warning's noticeability, including pictorials, icons, color, less label clutter, horizontal warning placement, and placing the warning on the front of the container. Contrary to expectations, a border around the warning did not improve noticeability. Combinations of design features did not necessarily improve the speed at which participants noticed the warning; although some combinations improved speed, other combinations did not (e.g., adding an icon improved speed but only with black coloring). The results suggesting that less label clutter, horizontal warning placement, and warning placement on the front of the container improved speed to notice the warning were replicated in a study with a similar experimental design (Godfrey et al., 1991). In addition, the phrase, "Government Warning" also reduced response times. Consistent with the response time studies, a horizontal alcohol warning was rated more conspicuous (Malouff, Schutte, Wiener, Brancazio, & Fish, 1993).

Several recent studies investigating the potential design improvements that were included in the 1999 petition to change the alcohol warning label found that the existing alcohol warning message was rated as more legible and more noticeable when changed to have fewer characters per inch, larger size, and horizontal placement (Swasy, Mazis, & Morris, 2002). Mazis, Swasy, & Morris (2003) evaluated the effects of symbols, lexicons (a few words used to summarize a health risk), and clutter (operationalized as additional information on the product) on warning message noticeability. The largest effect was observed when a brief message or symbol was placed on the front of the container. Similar to previous studies, clutter reduced warning noticeability, and a warning border did not significantly improve noticeability. Discovering which factors improve the noticeability of the alcohol warning label in a laboratory is necessary for effective warning design, but the

warning must be noticeable in natural contexts for it to be effective. Laboratory studies allow more control, but they may not generalize to the real world, whereas studies in a natural context lack the experimental control of the laboratory (see MacKinnon, 1995, for more on methodological issues in the evaluation of alcohol warning labels). The U.S. alcohol warning was an intervention delivered to the entire country at the same time, precluding selection of a randomized control group. Therefore, warning noticeability could only be examined by determining whether people saw the warning that was implemented in a natural context. These studies generally employed a pre- and post-test design; however, a few studies were able to make use of naturally occurring, nonequivalent control groups.

In a Gallup organization telephone survey, 35% of U.S. respondents thought that it was very likely that alcohol beverage containers displayed a warning in May 1990 ( $N = 1,020$ ) after the warning was required on containers, compared with only 23% of respondents in May 1989 ( $N = 1,008$ ), prior to the warning (Mazis, Morris, & Swasy, 1991). Similarly, more respondents (11%) thought it was very likely that alcohol containers displayed the risk of birth defects after the warning was required than before the warning was required (3%), and the difference was larger for those who drank alcohol. Although this indicates that some people saw the warning, the percentage increase was small.

Another large national telephone survey, with cross-sectional measurements before and after the warning was required on alcohol containers, also found an increase, prewarning to postwarning, in the percentage (8% to 27%) of respondents who had seen the alcohol warning (Kaskutas & Greenfield, 1992). This U.S. data was compared with data from Canadian residents because alcohol containers did not have a warning in Canada. More U.S. residents had seen the warning and knew the risks on the warning than Canadian residents providing additional evidence to suggest that changes in warning exposure were the result of the label rather than secular changes (Graves, 1993). By 1994, 43% of lifetime drinkers in the U.S. had seen the warning, compared with fewer than 20% of lifetime drinkers in the Canadian sample (Greenfield, Graves, & Kaskutas, 1999). In an analysis of the same survey data including only pregnant women and women who expected to become pregnant in the next 5 years, Kaskutas, Greenfield, Lee, and Cote (1998) found an increase in self-reported exposure to alcohol warnings over time. Improving the evidence for exposure to the warning on alcohol containers, this trend was not evident for exposure to signs or posters warning of this risk of alcohol-related birth defects. In a later analysis of these data employing diffusion models, Greenfield and Kaskutas (1998) found that the increase in current drinkers' exposure to the alcohol warning label leveled off in 1994.

A survey in Utah compared non-Mormon residents with Mormon residents, who generally refrain from drinking alcoholic beverages and would not likely see the warning on containers in stores because the state of Utah limits most alcohol sales to liquor stores (Mayer, Smith, & Scammon, 1991; Scammon, Mayer, & Smith, 1992). Data were collected prior to the warning's appearance on alcohol beverage containers during 1989, right after the warning was required on con-

tainers, and then 1 year later. The increase in warning awareness prewarning to postwarning was significantly higher for non-Mormon and less-devout Mormons than for devout Mormons. Similar to other studies, awareness of the warning increased more for people who drank alcohol than for those who abstained.

A survey administered in school to cross-sectional classroom samples of Marion County, Indiana, 10th ( $N = 9,787$ ) and 12th grade ( $N = 4,591$ ) high school students both before and after the warning was required showed results similar to the studies with adults: Increases in the percentage of students reporting that there was a law mandating alcohol warning labels (19% to 48% for 12th grade-students) and in the percentage of students who had seen the warning (26% to 47% for 10th grade students) over a 3-year period from 1989 to 1991 (MacKinnon, Pentz, & Stacy, 1993; MacKinnon, Pentz, Stacy, & Taft, 1993). During the same period, awareness of the law mandating cigarette warnings did not change, thereby reducing the probability that the results could be explained by secular trends. The change across time did not differ across receiver characteristics (Nohre, MacKinnon, Stacy, & Pentz, 1999), with the exception of alcohol use; more alcohol use was associated with a higher likelihood of seeing the warning and awareness of the law. Additional years of data (1989 through 1995) indicated that the initial increases in awareness and exposure leveled off approximately 3.5 years following the warning implementation (MacKinnon, Nohre, Pentz, & Stacy, 2000).

A large survey study ( $N = 5,169$ ) of African American women attending a prenatal clinic in an inner-city Detroit neighborhood suggested that awareness of the alcohol warning label among these women did not increase until February 1990 (Hankin et al., 1993). Prior to November 18, 1989 (the date the warning was mandated on all new containers of alcohol), 35% of the women in the prenatal care clinic were aware of the warning, which increased to an average of 56% for data collected from early June to the end of September 1991.

A sample of Hispanic residents living in San Francisco was interviewed by telephone in 1989 just before the warning was introduced and then each year through 1992 (Marín, 1997). Awareness (saw, read, or heard about the warning) of the birth defects risk significantly increased over time, as did awareness of the impaired driving risk. In a corresponding longitudinal study of Hispanics and non-Hispanic Whites measured before and 1 year after the warning, there was a significant increase in awareness of the warning on beer and wine containers and a decrease in awareness of a cigarette warning (Marín & Gamba, 1997) consistent with the introduction of the alcohol warning but no change to the tobacco warning.

### Memory and Comprehension

With natural warning label exposure, people may not see the alcohol warning, they may see it but not cognitively process it, they may read the label, or they may read, comprehend, and describe it to others. One laboratory study (MacKinnon, Stacy, Nohre, & Geiselman, 1992) showed that of four



memory tests for the warning (free recall, recognition, word-stem completion, and controlled association), free recall was the most sensitive measure to the different levels of processing. An additional condition in which participants were only cued to the warning suggested that they remembered the warning from situations outside the experiment because their memory for the warning was better than participants in the control condition.

Substance use, alcohol or tobacco, should increase the chances that persons see and remember the warnings on these products because the warnings appear on the alcohol and tobacco packaging. Therefore, more substance use should result in more accurate memory of the warning after the warning appeared on alcohol beverage containers. Two samples of college students had a positive association between use and recognition memory (identifying the risks on the warning from a list of risks) for alcohol, cigarettes, and smokeless tobacco (MacKinnon & Fenaughty, 1993). As use increased, memory increased. The alcohol use and memory correlation was replicated in samples of 10th and 12th grade high school students (MacKinnon, Pentz, & Stacy, 1993). This study provided additional evidence for the association because there was not a statistically significant correlation between alcohol use and memory before the warning was required to appear, but the correlation was statistically significant after the warning was required.

In the survey of Utah residents, 39% of respondents were able to accurately recognize two risks that were actually part of the alcohol warning (birth defects and impaired driving) and correctly reject two risks (leukemia and liver cirrhosis) as not part of the warning (Mayer et al., 1991; Scammon et al., 1992). Surveys of high school students (MacKinnon, Pentz, & Stacy, 1993; MacKinnon, Pentz, Stacy, & Taft, 1993) indicated that correct identification of the four risks described in the warning and correct identification of two distracter risks of alcohol consumption increased from the prewarning measurement through two postwarning measurements (3.6, 4.3, and 4.5 correct on a scale of 0 to 6, respectively). Similar to the results for warning exposure, the increases in adolescents' memory for the risks on the warning leveled off approximately 3.8 and 4.9 years after the warning was implemented for 10th and 12th grades, respectively (MacKinnon et al., 2000). There was evidence that the appearance of the Arizona poster warning of the risk of birth defects led to increased awareness of and exposure to the warning poster in a sample of college students measured before and after the legislation became effective on January 1, 1992 (Fenaughty & MacKinnon, 1993; MacKinnon, Williams-Avery, Wilcox, & Fenaughty, 1999).

Experimental studies of the alcohol warning are inconsistent regarding the relation between exposure to the content of the warning and memory. Some studies do not find that manipulating variables related to noticeability improves memory (Mazis et al., 2003). In contrast, a horizontal alcohol warning was rated more conspicuous and led to more accurate memory for the warning than a vertical warning (Malouff et al., 1993). Alcohol warnings shown in print advertisements also suggested that large, bold print and high-contrast warnings were remembered better than less conspicuous warnings, but an icon did not

significantly improve memory relative to plain print warnings (Barlow & Wogalter, 1993).

### Attitudes and Beliefs

Most U.S. and Canadian adults support warnings on alcohol beverage containers, although support is higher in the United States than Canada (Giesbrecht & Greenfield, 1999). During 1986, a national poll ( $N = 1,559$ ) indicated that 79% of the U.S. adult population supported a federal law requiring alcohol warning labels (Gallup Report, 1987). Public support increased over the years, such that 87% of adults in a national survey in 1989 before the warning appeared ( $N = 2,006$ ) supported the warning, and 91% of adults in the cross-sectional survey ( $N = 2,017$ ) supported the warning in 1991, after the warning appeared (Hilton & Kaskutas, 1991; Kaskutas, 1993a). Both drinkers and non-drinkers continued to support (92%) the warning label policy in 1994 (Greenfield, 1997).

In a study of the New York City Warning Poster, 54% of the persons interviewed before the warning poster appeared mentioned birth defects as a possible consequence of a pregnant woman's alcohol consumption (Prugh, 1989). A year after the poster had appeared, 68% mentioned birth defects. The results of this study suggested that warning posters do have the capability of increasing awareness of the possible consequences of a pregnant woman's alcohol consumption.

Even though most people (89%) in 1989 did not believe that the warnings would change heavy drinking, and a large percentage of persons (69%) thought that they already knew the hazards associated with drinking, 84% still thought that alcohol beverage containers should display a warning for even the slightest suspicion of danger (Hilton & Kaskutas, 1991). In addition, people favored the warning over other alcohol control policies, such as server interventions, that may have been more restrictive (Kaskutas, 1993a).

In a cross-sectional Gallup telephone survey, the percentage of people who believed alcohol was "very harmful" significantly increased from before the warning was on containers in 1989 to after the warning appeared on containers in 1990 (Mazis et al., 1991). A second national interview survey did not find an increase, prewarning to postwarning, in knowledge of the health risks mentioned in the warning, but the measure may have had a ceiling effect because most people already believed the risks disclosed on the alcohol warning (Greenfield, Graves, & Kaskutas, 1993; Greenfield & Kaskutas, 1993; Kaskutas & Greenfield, 1991, 1992). The study did find that adults who stated that they saw the warning were more likely to believe the risks than those who had not seen the warning. In addition, residents in the United States were more likely to believe that alcohol causes birth defects and health problems than Canadian residents (Graves, 1993).

There was inconsistent evidence regarding the association between the appearance of the Arizona warning poster and beliefs in a college student sample. There was some evidence that the perceived risk of drinking while pregnant significantly increased in samples of high school students collected before and after the alcohol warning poster was required to appear

(MacKinnon et al., 1999). In both samples, there was evidence that the effects of the warning poster leveled off over time.

Tenth and 12th grade students were asked whether alcohol could cause each of the four risks on the alcohol warning label. There were no significant trends associated with the implementation of the warning. However, most students already believed that alcohol consumption could result in these negative consequences at the prewarning measurement (MacKinnon et al., 2000; MacKinnon, Pentz, & Stacy, 1993; MacKinnon, Pentz, Stacy, & Taft, 1993).

A study examining risk believability and attitudes about five warnings proposed for alcohol advertisements—risk of birth defects; impaired driving; hypertension, liver disease and cancer; addiction; and dangerous if used in combination with other drugs—indicated that all of the warnings were believable and evoked positive attitudes (Andrews, Netemeyer, & Durvasula, 1990, 1991). The risk of birth defects and impaired driving were the most believable, and the risk of birth defects produced the most favorable attitudes. In addition, more favorable attitudes toward drinking alcohol were generally associated with less favorable attitudes and less believability about the alcohol warnings. In another analysis of the same data (Andrews, Netemeyer, & Durvasula, 1993), the association between alcohol attitudes and warning attitudes was mediated by net support for the warning (supportive thoughts written down after reading each warning minus arguments against the warning listed).

Laboratory research on alcohol warning labels in magazine advertisements has indicated that advertisements increase persons' perceived benefits of alcohol and decrease the perceived risks of alcohol but the effects of the warning were less straightforward (Snyder & Blood, 1992; MacKinnon & Lapin, 1998). One study suggested the warning produced a boomerang effect, such that drinkers perceive more benefits of alcohol after viewing advertisements with warnings than after viewing advertisements without warnings (Snyder & Blood, 1992). Two experiments that eliminated the confounding between sex and drinking status in the previous study and increased the power to detect the effect did not replicate the boomerang effect (MacKinnon & Lapin, 1998).

### Motivation

US and Canadian citizens who saw the alcohol warning label reported more conversations about drinking during pregnancy than persons who did not report seeing the label. Among the subpopulation of pregnant women and women who intended to become pregnant within the next five years, however, conversations about drinking during pregnancy significantly declined from 1990 to 1994 (Greenfield et al., 1999; Greenfield & Kaskutas, 1993; Kaskutas et al., 1998).

A series of questionnaire studies examined college and high school students', self-reported avoidance behavior in relation to alternative alcohol warning labels using a preference-based measure (MacKinnon, 1993; MacKinnon, Nemeroff, & Nohre, 1994). The participants were asked to choose an alcohol beverage container with a warning, without a warning, or state that

it would not matter (high school students were also given the option of stating that they did not drink, and a replication study of college students included the option of neither container). The warnings "poison," "toxic," and "causes cancer" produced the largest avoidance response effects, larger than the current alcohol warning label or any of its component risks. Avoidance responses were affected by the specific risks mentioned more than the length of the warning. In addition, fewer avoidance responses occurred with warnings including qualifier words, such as "may" and "GOVERNMENT WARNING: According to the Surgeon General."

### Behavior

In a study conducted in a bar, 75 patrons were randomly assigned to a control group with no intervention or an experimental group wherein the clientele were asked whether they had noticed the warning on the container of alcohol they had just consumed and how much of the warning they could recall (Malouff et al., 1993). Afterward, the number of drinks consumed was tallied from bar's receipts. The control clientele drank more alcohol during their time at the bar than the clientele who were approached, and more warning recall was associated with less alcohol consumption. Although one interpretation of the study is that a cue to the warning decreases alcohol consumption, contact with the researcher could also have produced the effect because there was no researcher contact with the patrons in the control group.

Reports of limiting drinking for health reasons were positively related to warning exposure and increased over time from 1990 to 1994 in large, representative samples of U.S. and Canadian adults (Greenfield et al., 1999). In a linked longitudinal sample of high school students across 3 years that began while the students were in the 10th grade approximately 1 year after the warning was required, three possible effects of warning exposure were tested: a deterrent effect where the effect of the warning is to decrease alcohol use, an exposure effect where alcohol consumption increases exposure and memory, and a harmful effect where the warning increases alcohol use. The results of three separate approaches to modeling longitudinal data suggested that there was no evidence for the deterrent effect, the harmful effect, or a combination effect, but there was evidence for an exposure effect; the more people consumed alcohol, the greater their exposure to and memory for the content of the warning (MacKinnon, Nohre, Cheong, Stacy, & Pentz, 2001).

Five years following the introduction of the warning on alcohol beverage containers, there was no self-reported evidence that high school students' drinking, drinking to the point of intoxication, driving after drinking, or riding with someone who was driving after drinking had decreased in cross-sectional samples of students (MacKinnon et al., 2000). In the adult population, however, self-reported evidence suggested that people were altering their driving habits based on the alcohol warning label. Persons who successfully recalled the drinking and driving risk from the warning were more likely to report that they had limited drinking because they knew they would have

to drive, and they had decided not to drive following drinking too much (Greenfield & Kaskutas, 1993).

The surveys of pregnant African American women living in Detroit suggested that between June and September 1991, non-risk drinkers (alcohol consumption of less than 0.5 ounces per day) significantly reduced their alcohol intake during pregnancy (Hankin, Sloan, et al., 1993). In an analysis of a longer time period from prewarning to postwarning (May, 1989 to June 1994;  $N = 9,797$ ), there was evidence for a modest reduction in drinking, but only for pregnant women under the age of 21 years (Hankin, 1996). Hankin discussed the familiarity effect (product familiarity decreases the likelihood of warning compliance) as one of the potential reasons only younger women would reduce their alcohol intake. The familiarity effect could operate with either pregnancy or alcohol, such that younger women may have been less familiar with pregnancy or alcohol because they have had less time to have taken risks.

A more recent time series analysis (adjusted for unemployment rates and seasonal dependencies) of pregnant African American women ( $N = 21, 127$ ) surveyed between 1986 and 1995 showed a significant, modest decline in drinking during pregnancy 8 months after the law went into effect but drinking during pregnancy in later measurements returned to the prewarning rates (Hankin, Sloan, & Sokol, 1998).

### Summary of Alcohol Warning Label Research

Overall, the studies of the U.S. alcohol warning label suggest effects in the early stages of behavior change (McGuire, 1980). The results are consistent across two national telephone surveys of adults (Greenfield, et al., 1993; Mazis et al., 1991), surveys in Marion county, studies of Indiana adolescents (MacKinnon, Pentz, & Stacy, 1993), interviews with pregnant women in a Detroit hospital (Hankin, Firestone, et al., 1993), and interviews with Utah adults (Scammon et al., 1991). The effects of the warning poster show a similar pattern (MacKinnon et al., 1999). There are substantial changes in awareness of and exposure to the warning. Individuals also appear to be reading the warning because memory for its content has increased. In contrast to effects on awareness and memory, there has been no consistent evidence that beliefs about or perceptions of the risks changed after the label appeared. One explanation is that there is a ceiling effect on these beliefs because many people already believe these risks.

There is no convincing evidence for general alcohol warning label effects on behavior, such as alcohol consumption and driving after drinking. Most of the risks on the warning refer to hazards in specific situations; therefore, behavioral changes may be seen in these specific situations rather than in more general situations. Hankin and colleagues (1993) did find a reduction in drinking among pregnant women, but only among low-risk, not high-risk, drinkers. Across studies, there has been little evidence that alcohol use has decreased. The evidence for reductions in drinking and driving is inconsistent. More adults who could remember the warning also reported limiting driving after drinking than adults who could not remember the warning (Greenfield & Kaskutas, 1993). Self-reported changes

in adolescents' drinking and driving behavior were not found, however. Nor has there been evidence for declines in drinking while operating machinery. Although health problems are not situation-specific, there also was no evidence for reductions in alcohol-related health problems.

Changing the design of the current alcohol warning label could improve the noticeability of the warning. Many of these improvements were included in the petition to the U.S. Bureau of Alcohol and Tobacco, but it appears that these changes will not be made. Horizontal placement of the warning, placement on the front of the container, pictorials, color, and icons improve ratings of conspicuousness, speed to notice the warning, and memory for the warning. All of these factors, however, may not simply add to improved noticeability, as the effect of one improvement may depend on whether other improvements are made. Even if design changes improve noticeability and memory for the warning, the changes may not influence a person's risk perceptions or behaviors.

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### TOBACCO WARNING LABEL RESEARCH

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There are a variety of research designs used to study the tobacco warning label, including laboratory experiments, econometric analysis, and large survey studies. Most of the studies reviewed in this section investigated research on tobacco warnings in Australia, Canada, and the United States.

#### Attention and Noticeability

In an eye-tracking study of attention to the tobacco warning label among 61 adolescents, the average time viewing the warning was only 8% of the total time spent viewing tobacco advertisements (Fischer, Richards, Berman, & Krugman, 1989). A later study of alcohol and tobacco warnings on print advertisements found that the proportion of adolescents who looked at the warning and the amount of time spent viewing the warning were affected by the specific advertisement, suggesting that warnings need to be studied in context (Fox, Krugman, Fletcher, & Fischer, 1998). Observers in a car could identify the warning on 46% of billboard ads, 5% of highway billboard ads, and none of taxicab ads (Davis & Kendrick, 1989). Using eye-movement technology, Krugman, Fox, Fletcher, Fischer, and Rojas (1994) found that two new tobacco warnings attracted the attention of more participants and were seen more quickly than the mandated warnings. The new warnings were developed based on standard advertising practices, including identifying the target audience, consulting with communication experts, and evaluation using focus groups. The warnings were "Smokers inhale carbon dioxide," with either a white or bright yellow background, and "Cigarettes kill. One in every 3 smokers will die from smoking." The new warnings used different fonts and graphics.

Popper and Murray (1989) investigated aspects of smokeless tobacco warnings in a sample of 270 college students. They concluded that increasing the size of the font by 40% (from 10 to 14

points) or changing the background of the warnings from gray to white did not significantly increase warning communication.

The percentage of Swedish citizens who noticed tobacco warnings increased after the 1997 requirement that one of 16 different health warnings appear on tobacco packaging (Daube, 1982). Kaiserman (1993) interviewed persons outside a Canadian shopping mall after tobacco warnings were required to be more legible and to have contrasting colors in 1989. Most (95%) respondents noticed the warning when shown a pack of cigarettes, and 81% indicated that the warning was easy or very easy to pick out. Borland (1997) reported two national cross-sectional, representative, samples of Australian smokers taken before (December, 1994) and after (May, 1995) the warning was changed to include six rotating warnings, with text on the flap and back of the cigarette packaging. After the warning was introduced, 66% of respondents said that they noticed the warning at least sometimes, compared with 37% at baseline. In another analysis that included nonsmokers, Borland and Hill (1997) found that unprompted reports of recent changes to the cigarette warnings (e.g., larger or different placement) suggested that 91% of smokers and 51% of nonsmokers were aware of the new warnings at follow-up (vs. 28% and 24% at baseline, respectively).

In 2000, Canada required a warning consistent with human factors design for warnings, including graphic displays, information on how to avoid the risks in the warning, and, ensuring that the warning occupied 50% of the package (Strahan, White, Fong, Fabrigar, Zanna, & Cameron, 2002). Fong (2003) reported important results of a survey of high school students in Canada (9 schools,  $N = 7,400$ ) and the United States (6 schools;  $N = 4,600$ ) measured before (Fall 2000) and after (Spring 2001) the graphic Canadian tobacco packaging was introduced. There was a significant increase in noticing the labels among Canadians and a decrease among Americans. In a separate survey of Canadian adult smokers after the warning appeared, 91% of the smokers responded that they had seen the warning (Hammond, Fong, McDonald, Cameron, & Brown, 2003).

## Memory and Comprehension

In an eye-tracking study by Fischer et al. (1989), adolescents who viewed US tobacco warnings for a short amount of time showed recognition memory only slightly better than chance. In a later study, Fischer et al. (1993) compared a mandated warning with two potential new warnings following different lengths of timed viewing of an advertisement. In a convenience sample of 220 adolescents, recall for the content of the mandated warning during masked recall was considerably lower than recall for the new warning (15% vs. 66%), and recognition memory showed a similar difference. The authors concluded that the mandated cigarette warning failed as a public health approach and new policies were required.

Bhalla and Lastovicka (1984) found that varying pictorial format but not changing warning content influenced warning message comprehension in a sample of 84 college students. Brubaker and Mitby (1990) found that only half of the 192 high school participants remembered seeing a warning on smokeless

tobacco products and, of those who saw the warning, a third recalled the content of the message. A convenience sample of 895 men aged 16 to 24 years, intercepted at seven shopping malls in Massachusetts, were randomly assigned to one of eight groups defined by warning label contrast (high or low) and font size (8, 10, 14, or 18 points; Truitt et al., 2002). Two advertisement distracter ads were also included. Recall of the warnings was greater for larger warnings and warnings with more contrast, although the contrast effect did not reach conventional levels of statistical significance. The experimental studies of warning exposure on memory are limited because exposure to the warning is only once or a few times, whereas actual warnings are seen repeatedly (Bhalla & Lastovicka, 1984).

As described in the alcohol section, substance use should increase the chances that a person sees and remembers the warnings because the warnings appear on the packaging. MacKinnon and Fenaughty (1993) investigated this prediction in two samples of college students and found there was a positive association between use and recognition memory (identifying the risks on the warning from a list of risks) for cigarettes ( $r = .32$  and  $.34$ ), and smokeless tobacco ( $r = .23$  and  $.32$ ). Robinson and Killen (1997) also found that the level of smoking was significantly related to knowledge of warning labels in a sample of 1,747 9th graders. In contrast, Richards, Fischer, and Conner (1989) reported only a small difference in knowledge of cigarette warnings between smokers and nonsmokers in a sample of 202 adults surveyed in a shopping mall.

Hill (1988) reported the results of a study of tobacco warnings in Victoria, Australia, which became effective in September 1987. Two household surveys were conducted before ( $N = 582$ ; September and October, 1986) and after ( $N = 1154$ ; September and October, 1987) the label was required to appear. Both smokers and nonsmokers were better able to recall the new warnings, although the change was larger for smokers, which can be explained by the increased exposure to warnings among smokers.

Borland and Hill (1997) surveyed approximately 1,022 persons before and 1,046 persons after the Australian warning changed in 1995. Recall of each of the new health warnings significantly increased among both smokers and nonsmokers, and the mean number of risks recalled increased. The "Smoking Kills" warning recall increased for smokers from 6% to 55%. Ninety-four percent of smokers and 56% of nonsmokers recalled at least one risk of smoking.

Recent studies of the new pictorial warning in Canada suggest substantial memory for the new warnings. Most smokers had knowledge of the content of the new warnings (Hammond et al., 2003) measured about 9 months ( $N = 616$ ) and 12 months ( $N = 432$ ) after the new picture warnings were required in Canada. Seventy percent of the smokers correctly recognized three actual and three bogus warning messages.

## Attitudes and Beliefs

Most of the 727 college students surveyed by Beltramini (1988) believed the single U.S. warning adopted in 1972 and the current four rotating U.S. warning labels. Overall, the single warning from 1972 was most believable, followed by "Surgeon

General's Warning: Smoking Causes Lung Cancer, Heart Disease, Emphysema, and May Complicate Pregnancy," "Surgeon General's Warning: Smoking by Pregnant Women May Result in Fetal Injury, Premature Birth, and Low Birth Weight," "Surgeon General's Warning: Quitting Smoking Now Greatly Reduces Serious Risks to Your Health," and "Surgeon General's Warning: Cigarette Smoke Contains Carbon Monoxide." Cecil, Evans, and Stanley (1996) investigated the perceived believability of U.S. tobacco warnings among 691 5th through 12th graders. Overall, smokers were significantly less likely to believe the risks mentioned on three of the four mandated warnings. The "Cigarette Smoke Contains Carbon Dioxide" warning was the only warning without a significant difference between smokers and nonsmokers. Girls rated all warnings as more believable than boys. Advertisements with warnings were perceived as less attractive and less persuasive than the same advertisement without warnings in 115 college students (Loken & Howard-Pitney, 1988).

In a study of proposed European Union warnings (Portillo & Antoñanzas, 2002), Spanish college students ( $N = 345$ ), attributed greater health risks to smoking after viewing the health warnings on cigarette packages. After viewing the cigarette packages, more students stated that smoking was a risk factor for lung cancer, cardiovascular diseases, and diabetes. Although there was no corresponding increase for respiratory diseases, 96% percent of the students already believed this risk factor. Students' perceived risk of disease for smokers relative to nonsmokers, and the perceived number of smokers out of 100 who will get the disease increased after viewing the new warnings. The risks of disease associated with passive smoke exposure also increased. In the Borland and Hill (1997) survey, smokers were asked whether smoking caused any illnesses and, if so, to name the illness. Although smokers reported fewer illnesses associated with smoking than nonsmokers, smokers listed more health-related effects of smoking following the introduction of the new warnings than before.

Hammond, Fong, McDonald, Brown, and Cameron (2004) reported that the graphic Canadian warnings evoked fear and disgust in about half of smokers surveyed. Moreover, smokers who reported that the warning evoked fear and disgust were more likely to report that the warnings had reduced the amount that they smoked, that they had successfully quit smoking, or that they attempted to quit 3 months later.

### Motivation

Brubaker and Mitby (1990) did not find a significant effect of U.S. warning exposure in an experiment on intentions to use smokeless tobacco among high school students. In an experimental study of 109 Australian smokers, the effect of exposure to the warning that smoking causes heart disease had an indirect effect on perceived likelihood of giving up smoking through perceived expectancy of health risks (Ho, 1992). In the Hammond et al. (2004) study, 36% of Canadian smokers reported some type of avoidance behavior toward the new graphic warnings, including covering the warning, requesting a specific pack, and using a cigarette case.

### Behavior

Abernethy and Teel (1986) developed two econometric models for U.S. tobacco consumption from 1949 to 1981. Both models included predictors coding the introduction of the tobacco warning label. Three changes in the warning were examined along with print tobacco advertisement spending and broadcast advertising spending, lagged tobacco consumption, fairness doctrine anti-smoking broadcasts, and the 1971 television and radio advertising ban. The dependent variable was pounds of tobacco consumed per capita among persons aged 16 years and older. In Abernethy and Teel's first model, there were no transformations of the dependent variable, and variables coding the effect of the warnings were nonsignificant. In the second model, the logarithmic transformation of the tobacco consumption dependent variable was taken, and two of the three warning label variables were statistically significant, the 1966 warning and the 1970 warning, but not the 1972 warning change. Simonich (1991) developed a comprehensive econometric model of similar data that improved on the Abernethy and Teel (1986) model in several important ways. Simonich argued that Abernethy and Teel's model contained specification error because the following effects were not estimated: effects of income, introduction of new cigarette brands, 1964 Surgeon General's report, tar and nicotine listing requirement, state smoking rules, and nicotine yields. In Simonich's more comprehensive model, there was not a significant effect of any of the warning label predictors on cigarette consumption. Simonich notes that multicollinearity among the warning label variables is a possible statistical explanation. Similarly, it is also likely that the other predictors of cigarette consumption made it difficult to detect the warning label effects. Other variables in the model were statistically significant, such as the effects of taxes and smoking rules, and Simonich (1991) suggested that the content of the warning labels could be changed to provide a link with these effective strategies, with warnings such as, "A pack a day costs you over \$500 per year," or "Your smoking hurts those closest to you" (p. 192).

These econometric analyses by Simonich (1991) and Abernethy and Teel (1986) evaluated warning labels on aggregate measures, making it difficult to detect warning label effects that are likely to be small. Fortunately, researchers in Australia and Canada conducted surveys of individuals before and after warning label changes, which may provide a more sensitive gauge of warning label effects. After the new warnings were introduced in Australia, 14% of a national sample of smokers said that they refrained from smoking on at least one occasion after the warning change, compared with 7% before the warning change (Borland, 1997). In a smaller sample ( $N = 243$ ) of the baseline smokers who were re-contacted, persons who said that they refrained from smoking at least one time because of the old warning at baseline were more likely to have tried to quit smoking at the second measurement.

Robinson and Killen (1997) conducted a longitudinal study of the association of U.S. cigarette warning exposure and cigarette use among adolescents. They found that early exposure to the cigarette warning was positively associated with cigarette use 3 months later and concluded that the warning

label was ineffective. Another interpretation of this result is that persons more likely to see the tobacco warning at earlier waves are more likely to become smokers later. They may have seen the warning label on a friend's or family member's package of cigarettes. In other words, the effect could be another exposure effect, whereby more use or more exposure to users leads to more exposure to the warning.

A total of 19% of the 616 adult smokers indicated that they smoked less as a result of the new Canadian warnings, and 1% reported that the warning made them smoke more (Hammond et al., 2003). Also, 63% reported at least one cessation benefit of the warnings, and only 6% reported any negative impact of the warning.

As described earlier, Fong (2003) reported a significant increase in noticing the graphic tobacco warning labels among Canadians and a decrease among Americans prewarning to postwarning. The increase in the perceived effectiveness of warning labels in pointing out health problems of smoking was greater in the Canadian sample, and Canadian respondents indicated that the warning was more likely to make them hesitate to have a cigarette. Most importantly, the percentage of smokers who intended to quit increased in Canada but decreased in the U.S. sample. The results support a positive change associated with the introduction of the Canadian graphic warning label.

### Summary of Research on Tobacco Warnings

There is less research on tobacco warnings than alcohol warnings but the results of these studies are more promising. Although some early research suggested that there were not very large effects of warnings, more recent studies of the Canadian and Australian warnings suggest that these warnings may have beneficial effects on tobacco cessation. The warning changes that will occur as part of the World Health Organization treaty should provide further opportunities to assess the effects of tobacco warning labels. The best quasi-experimental designs should be used to evaluate these warning changes including multiple prewarning and postwarning measures (Fong, 2003), comparison groups (Mayer et al., 1991), comparison variables (MacKinnon et al., 2000), and other approaches that address alternative explanations of results (Shadish, Cook, & Campbell, 2002).

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## DISCUSSION AND FUTURE DIRECTIONS

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Alcohol and tobacco are similar products in that both are recreational drugs with some favorable effects, but they also have severe health, social, and economic costs, including addiction. These problems have led countries to consider preventive measures. The U.S. government has required age-limit restrictions, has assessed substantial taxes, and has required health warnings on the labels for both products. The U.S. public has generally accepted the use of alcohol and tobacco products with exceptions, including the prohibition of alcohol and current negative social norms against tobacco use.

Recent research on alcohol has suggested some beneficial health effects of moderate use. Beneficial health effects of tobacco have not been documented, and research has continued to point out the harmful effects of both smoking and passive smoke. The climate in the United States and many other countries has become less accepting of tobacco use over time. The increasing number of smoking bans in both public and private establishments across the United States and increasing local taxes on tobacco support this climate change.

It is reasonable to expect the effects of tobacco and alcohol warnings to differ as a result of these different social norms and risk perceptions. Perceiving products as more harmful increases the likelihood that persons will look for, read, and comply with the warnings and greater belief in safety information increases warning compliance (Godfrey, Allender, Laughery, & Smith, 1983; Goldhaber & deTurck, 1988; Wogalter, Brelsford, Desaulniers, & Laughery, 1991; Wogalter, Desaulniers, & Brelsford, 1987). Therefore, the changing public perception of the harmfulness of tobacco is likely to affect responses to the warning.

There are several other important differences between alcohol and tobacco warnings. One difference between alcohol and tobacco products that could differentially affect warning outcomes is that the alcohol risks on the warning are more immediate than those for tobacco (e.g., impaired driving versus lung cancer). The more immediate consequence of a vehicle accident may potentially produce a more powerful deterrent, or it could produce a more apparent false-alarm effect. With the exception of the warning of health problems, the risks on the alcohol warning are situation-specific: drinking while pregnant, driving a vehicle, and operating machinery. The risks on the cigarette warning label are specific health consequences but not situation-specific. Additionally, the warning label is on the alcohol container (when drinking out of the can or bottle), not the packaging as for cigarettes.

The natural experiments provide evidence that persons are aware of the alcohol warning label and have seen it (Greenfield & Kaskutas, 1993; Hankin, Sloan, et al., 1993; MacKinnon, Pentz, & Stacy, 1993; Mazis et al., 1991; Scammon, Mayer, & Smith, 1991). Similar results on exposure have been obtained for tobacco (Borland, 1997; Borland & Hill, 1997; Fong, 2003). The effect on memory has been observed in several field studies (MacKinnon, Pentz, & Stacy, 1993; Scammon et al., 1991) and laboratory exposure to the warnings is associated with improved but not perfect memory for the alcohol warning (Barlow & Wogalter, 1993; MacKinnon & Fenaughty, 1993; MacKinnon et al., 1992; Smith, 1990). There is evidence that memory for Australian and Canadian tobacco warnings increased after these warnings were introduced (Borland, 1997; Hammond et al., 2004).

More alcohol or tobacco use is associated with better memory for the content of the respective warning (MacKinnon & Fenaughty, 1993; MacKinnon, Pentz, & Stacy, 1993), and the effect of the alcohol warning label is stronger among alcohol users (Mazis et al., 1991). This contrasts with the familiarity effect, whereby product familiarity decreases looking for and reading a warning. The warning is on the package for cigarettes and container for alcohol; therefore, increased use increases the



chance that the warning will be noticed and read. The familiarity effect could still occur for compliance with the tobacco and alcohol warning.

There is not much evidence for an effect of alcohol warnings on perception of the risks, perhaps because most people already know the risks included in the warning. Perceptions of the risks on the warning have not decreased substantially, suggesting that overwarning or the false alarm effects mentioned earlier may not be operating. The measures of risk used in the natural experiments may not have been sensitive enough to capture changes from the warning. For example, there may be less response variability when asking whether alcohol can impair driving than when asking about the likelihood of a vehicle accident after consuming a certain number of drinks. Although people tend to believe the tobacco warnings studied, smokers generally believed the warnings less than nonsmokers. It appears that the proposed European tobacco warnings may increase perceptions of the risks associated with smoking. The Canadian tobacco warnings appear to induce an emotional response that appears to lead to attempts to reduce smoking, probably owing to the graphic nature of the warning.

The evidence suggesting that the alcohol warning label has affected behavior is not compelling. Although alcohol consumption during pregnancy decreased among low-risk drinkers, a similar decline was not apparent among high-risk drinkers (Hankin, Sloan, et al., 1993). U.S. adults who were aware of the warning reported curbing driving after drinking, but the warning did not appear to influence adolescents similarly. However, the general U.S. secular trend toward reduced traffic casualties is consistent with beneficial effects of the alcohol warning. Malouff et al.'s (1993) study suggests that cues to the warning may reduce alcohol use. Kaskutas (1993b) found that 55% of respondents said the alcohol warning label had affected their drinking. The alcohol warning may only influence behavior in small ways for some risk groups, which may depend on risk perceptions or product familiarity.

In contrast to the alcohol warnings, the Australian and especially the Canadian tobacco warnings appear to affect smoking behavior, with persons reporting more cessation attempts after the warning appeared as well as attributing quit attempts to the warning (Hammond et al., 2004). Importantly, there is evidence that the graphic Canadian warnings appear to reduce smoking by invoking more negative emotion (Hammond et al., 2004), suggesting that the mechanism of action of the warning may be through affecting emotional

responses. Similarly, the cognitive processing of the warning was associated with cessation behavior among smokers (Hammond et al., 2003).

As described earlier, alcohol labeling effects may differ from the effects of cigarette labels. Problems resulting from alcohol use are more immediate (e.g., impaired driving versus lung cancer) and related to specific problematic behaviors rather than use in general. In addition, the warning label is on the alcohol container (when drinking out of the can or bottle) not the packaging, as for cigarettes. The more negative social norm regarding tobacco use is another explanation of the more promising results of tobacco warnings. Although it has been and will continue to be difficult to disentangle the warning effects from social norm changes, the U.S. cigarette warning labels have not produced the type of self-reported response or behavioral intentions that the newer cigarette warnings in Canada and Australia have produced, even though social norms in the United States have also changed. The Australian and Canadian tobacco warnings are more powerful from a human factors perspective. The Canadian warning is large, vivid, and contains graphic pictures.

This chapter started with a polite, mild, warning on Japanese cigarette packages. It ended with the positive results of graphic Canadian warnings. Both tobacco and alcohol warnings have progressed from mild to more graphic content since they were introduced. The recent proposal to make the U.S. alcohol warning more noticeable is a sign of attempts to make the alcohol warning stronger. If the positive effects of the Canadian tobacco warning label are further verified, the next logical step may be to consider graphic alcohol warnings. It is easy to imagine these alcohol picture warnings, a gruesome car accident, diseased liver, abused spouse, or person regurgitating. Although these warnings may be effective from human factors perspective, actual implementation depends on societal and other considerations.

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