

Recall and Eye Tracking Study of Adolescents Viewing Tobacco Advertisements

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The warning on tobacco advertisements was required by the federal government, presumably as a health message to educate the public about the risks associated with tobacco use. Despite its potential public health role, there have been few published studies on the effectiveness of these warnings as a health message. The present study used well-accepted market research methods to examine adolescent viewing of tobacco advertisements. Sixty-one adolescents participated in the study. Eye tracking was used to study how participants viewed five different tobacco advertisements. The average viewing time of the warning amounted to only 8% of the total advertisement viewing time. In 43.6% of cases, the warning was not viewed at all. Following the advertisement viewing, participants were asked to identify the observed warnings within a list that included other simulated warnings. Subjects did only slightly better than random guessing in this test of recognition. Using market research criteria, the federally mandated warning must be viewed as an ineffective public health message in so far as adolescents are concerned.

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IN 1965, as a result of numerous scientific studies on the health hazards of smoking, legislation was passed requiring that a warning be placed on all cigarette packages.^{1,2} Threatened in many states with legislation that would have

See also p 90.

required harsher warnings on advertisements, the tobacco industry worked out a compromise in 1972 with the Federal Trade Commission (FTC) regarding the specific wording and the format of the warning.³ The warning was

changed in 1984 when four rotating messages were mandated by legislation, each describing a different health issue.⁴ In addition, a warning for smokeless tobacco advertisements and product packages was mandated in 1986.⁴ Because of the legislated wording of these various warnings, they are often referred to as *the Surgeon General's warnings*.

It is the contention of the tobacco industry that these warnings provide adequate information about the potential hazards of tobacco use and that the manufacturers are therefore exempt from product liability.⁵ Support for this legal position has come from cases argued successfully by the tobacco industry before the US Court of Appeals in Georgia, Pennsylvania, and Massachusetts (*Time*, Sept 7, 1987, p 43).⁶ However, in a more recent case argued before the

Minnesota Court of Appeals, a three-judge panel unanimously ruled that the federally mandated warnings do not protect tobacco companies from claims that they have failed to warn consumers of the dangers of smoking.

It remains unclear whether the current warnings adequately warn the public or are effective in discouraging the use of tobacco products. Research in the area of information disclosure has delineated the difference between "information provision" and "information impact."⁷ The latter is the central issue for whether warnings really warn, an issue for which even the Surgeon General has expressed concern.⁸

The effectiveness of the warnings to adolescents is a special problem. This group continues to demonstrate high rates of tobacco use.^{9,14} Furthermore, adolescents are the group from which most new smokers are recruited. Greater than 90% of smokers begin to smoke as teenagers.^{11,12}

While tobacco manufacturers claim that they do not advertise to children or adolescents (*Time*, April 9, 1984, p 91), there is considerable evidence that their marketing is "youth oriented."¹³ Research has demonstrated that tobacco advertising is well recognized by children and adolescents.^{15,16} In addition, it has been demonstrated recently that adolescent recognition of tobacco advertising correlates in a dose-response manner with cigarette use.¹⁷

This study was conducted to examine whether adolescents "read" and "recalled" the Surgeon General's warning when viewing tobacco advertisements. It involved the recording of eye tracking

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Fig 1.—Eye tracking apparatus in use.

data during advertisement viewing, as well as standard postviewing recall techniques used in market research.^{18,22}

MATERIALS AND METHODS

The study data were collected in July 1987. Participants were 61 paid adolescent volunteers (aged 13 to 17 years) who were recruited from a YMCA membership list. Subject and parental written consent were obtained prior to enrollment in the study and after explaining that the study involved measuring eye tracking while viewing advertisements. Information about age, sex, school grade, and smoking status was obtained with a written questionnaire. The self-report smoking status categories were similar to those that we have previously used.¹⁷ The reliability of the smoking status data was enhanced by employing the bogus pipeline technique.^{14,23-25}

Five advertisements (four cigarette and one chewing tobacco) were selected from current magazines. The tobacco brands chosen reflected the brands reported by adolescents as most popular in our previous study.¹⁷ The advertisements were mounted in a three-ring binder to allow subjects to view them in a manner consistent with reading a magazine. The viewing order for each of the five magazine advertisements was randomized for each of the study subjects. Participants were instructed to view the pages in the same way that they would view a magazine. Instructions were scripted to ensure uniformity. Participants were not told that they would later be questioned about the advertisements. No time limit for viewing was given.

Eye tracking was measured using an Eye View Monitor system (Applied Sci-



Fig 2.—Recorded image of subject's field-of-view. Time line and cursor (circled) are superimposed on videotaped image. (Simulated for publication purposes.)

ence Laboratory, Waltham, Mass, model 3100H). This system obtains an eye image by using lightweight optical components mounted on a headband that is worn by the subject (Fig 1). A coaxial camera and near-infrared light source within the optics produce a bright pupil image and a corneal reflection. Also fitted unobtrusively on the headband was a field-of-view video camera. The headband configuration permitted freedom of head motion and allowed a natural reading posture.

The pupil and corneal reflection information was videotaped. The signal containing the field-of-view was simultaneously recorded. The recorded data were then computer processed off-line to generate a data tape with a cursor, representing eyepoint of regard, superimposed on the field-of-view image (Fig 2). This permitted detailed analysis of the viewing behavior (Fig 3).

The tape was then analyzed frame by frame to determine total advertisement viewing time, viewing time of the warning, and the frequency and duration of visual fixations within the warning area. *Fixations* are periods of relative eye stability during which information is taken in for processing. These are distinguished from rapid motions between fixations (saccades) during which very little information is acquired. *Significant fixations* were operationally defined in this study as the absence of any eye movement greater than 1° of the visual angle for at least three frames (ie, 0.10 s). Fixations of this length have been reported to be characteristic of

reading activity.²⁶ A 10% random sampling of the recorded data was reanalyzed to measure the intraobserver reliability of the frame-by-frame analysis. This check of reliability showed that advertisement total viewing times and total fixations were within 0.1 s in 92% and 90% of cases, respectively.

Following the eye tracking measurements, each subject was asked questions about the advertisements they had seen using a masked recall technique. This market research technique is often utilized in situations where a low amount of learning is thought to have taken place.^{18,22} The advertisements were "masked" to cover all specific references to the brand of cigarette, the principal advertisement heading, and the Surgeon General's warning (Fig 4). The subjects were shown the masked advertisements in the exact sequence viewed during the corneal tracking study period. Each was asked to recall what was covered by the masked areas of the advertisement. The responses were recorded verbatim and were later scored for the pack, the heading, and the warning. As indicated in Table 1, credit was given for identifying the general wording of the heading or warning.

Finally, each subject was given a list of ten Surgeon General's warnings (Table 2). Five of these were the warnings on the five advertisements that had been viewed. Five other simulated warnings were also included. Each subject was asked to circle the five warnings that they remembered seeing during the advertising viewing period.

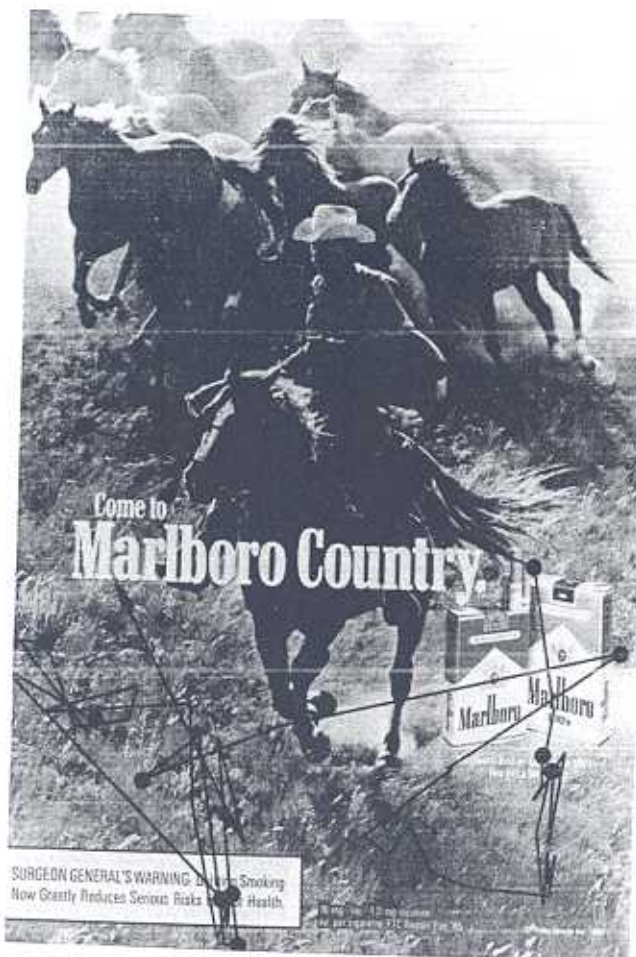


Fig 3.—Eye movement (arrow) and significant fixation points (dots) of typical advertisement viewing.



Fig 4.—"Masked" advertisement as used in recognition study. Pack, heading, and warning areas are covered.

Table 1.—Masked Recall Scoring

Masked Area	Score		
	1	2	3
Pack	Unable to identify	Identified as a pack	Identified specific brand
Heading	Unable to identify	Identified as a heading	Identified general wording of heading
Warning	Unable to identify	Identified as a warning	Identified general theme

These data were used as a measure of warning recognition.

The data were analyzed using χ^2 test, Kruskal-Wallis analysis of variance, and Spearman's correlational analysis. The Scheffé test for multiple comparisons was used to analyze viewing time differences among advertisements. The data are reported as mean \pm 1 SD.

RESULTS

The mean age for the 61 teenagers participating in the study was 15 ± 1.3 years. Sixty-four percent were male and 95% were white. The self-reported smoking status of the participants

showed that 30 (49%) had never smoked, 22 (36%) had experimented with cigarettes, and nine (15%) were regular smokers (more than one cigarette per week).

When asked about their favorite magazine, the most frequent responses were *Sports Illustrated* (43.6%), *Mademoiselle* (14.5%), *Newsweek* (9.1%), and *Cosmopolitan* (7.3%). Of the 13 favorite magazines mentioned, only two (*Seventeen* and *Boys Life*) do not carry cigarette advertisements. These two were reported to be the favorite magazine by one female and two male subjects, respectively.

Table 2.—Surgeon General's Warnings Used in Aided Recall

Real Warnings
1. Surgeon General's Warning: Quitting smoking now greatly reduces serious risks to your health.
2. Surgeon General's Warning: Smoking by pregnant women may result in fetal injury, premature birth, and low birth weight.
3. Surgeon General's Warning: Cigarette smoke contains carbon monoxide.
4. Surgeon General's Warning: Smoking causes lung cancer, heart disease, emphysema, and may complicate pregnancy.
5. Warning: This product may cause gum disease and tooth loss.
Simulated Warnings
1. Surgeon General's Warning: Cigarette smoke contains arsenic.
2. Surgeon General's Warning: Quitting smoking can help prolong your life.
3. Surgeon General's Warning: Smoking can cause wrinkling of your skin and make you appear older.
4. Warning: This product may cause halitosis.
5. Warning: This product may cause mouth cancer.

The eye tracking tape for 16 of the subjects was unacceptable for analysis because of technical problems (eg, drooping eyelid, inability to focus on the ocular reflexes). Two hundred two advertisements viewed by the remaining 45 subjects were available for analysis.

Table 3.—Surgeon General's Warning Characteristics and Viewing Times

Advertisement	Location on Page	Shape	Wording of Warning	Total Advertisement Viewing Time, s	Warning Viewing Time, s	Warning Time as Percent of Total Viewing Time
Winston (n = 44)	Left lower corner	Rectangle	"Cigarette smoke contains carbon monoxide."	8.47 ± 4.56	0.79 ± 0.93	8.5
Marlboro (n = 35)	Left lower corner	Rectangle	"Quitting smoking now greatly reduces serious risks to your health."	7.12 ± 3.29	0.55 ± 0.87	7.7
Red Man (n = 42)	Left upper corner	Arrow-into-circle	"This product may cause gum disease and tooth loss."	8.21 ± 4.42	0.62 ± 1.2	7.5
Virginia Slims (n = 39)	Left upper corner	Rectangle	"Smoking causes lung cancer, heart disease, emphysema, and may complicate pregnancy."	11.76 ± 7.74	0.55 ± 1.02	4.7
Camel (n = 42)	Right upper corner	Rectangle	"Smoking by pregnant women may result in fetal injury, premature birth, and low birth weight."	9.11 ± 6.72	1.25 ± 1.50	13.7

These 45 subjects included 22 (49%) who had never smoked, 18 (40%) who had experimented with cigarettes, and five (11%) who were regular smokers.

The mean viewing time for a single advertisement was 8.95 ± 5.75 s. Of this time, only 0.75 ± 1.17 s was spent viewing the warning (ie, 8% of the total advertisement viewing time).

The differences between the mean viewing times for the five advertisements were not statistically significant (Table 3). Neither the warning's content, its position on the page, nor its shape appeared from these limited data to influence the time spent viewing the warning.

Previous research has studied viewing behavior based on fixation time and content recall.^{18,26,27} For this study, viewing behavior was classified as "looking" activity, consisting of eye movement and short fixations (<0.10 s), and "reading" activity, which was characterized by visual fixations equal to or greater than 0.10 s. For all advertisements, the mean "looking" time for the warning was 0.52 ± 0.80 s. The mean duration of the warning "reading" time was 0.23 ± 0.51 s.

The 202 advertisement viewings were further analyzed according to the type of viewing of the warning. In 43.6% of cases there was no viewing of the warning. In 19.8% of cases, the warning was looked at but not read. In 36.7% of cases, some fixations equaled or exceeded 0.10 s, indicating that parts of the warning were read.

Following the eye tracking study, each participant was asked to identify masked areas of the five advertisements (Fig 4). These masked areas covered the cigarette pack, the main advertisement heading, and the Surgeon General's warning. The recall scores for the five separate advertisements were significantly different (Table 4). This was true for the pack, the heading, and the warning. Of note was the high pack

Table 4.—Masked Recognition Scores (N = 61)

Advertisement	Score		
	Pack	Heading	Warning
Winston	1.8 ± 0.65	1.1 ± 0.32	1.9 ± 0.54
Marlboro	2.4 ± 0.63	1.9 ± 0.86	2.1 ± 0.51
Red Man	2.4 ± 0.82	1.2 ± 0.44	1.4 ± 0.76
Virginia Slims	2.3 ± 0.93	1.6 ± 0.88	2.3 ± 0.70
Camel	2.1 ± 0.63	1.2 ± 0.46	2.0 ± 0.52
All advertisements	2.2*	1.4*	1.9*

*P < .001, F test for analysis of variance with Scheffé test (multiple comparisons of means).

Table 5.—Masked Recognition by Smoking Status (N = 61)

Smoking Status	Score		
	Pack	Heading	Warning
Nonsmoker (n = 30)	2.01	1.31	1.87
Experimenter (n = 22)	2.32	1.44	2.02
Regular smoker (n = 9)	2.60	1.69	2.04
P	<.001	.02	NS*

*NS indicates not significant.

recall for Marlboro and Red Man, the high heading recall for Marlboro and Virginia Slims, and the extremely low recall for the warning in the Red Man advertisement. The mean masked recall score of 1.9 for the warning correlates with identification of this masked area as a "warning" but without recall of its general wording. In comparison, the pack recall was higher (mean score, 2.2), while the heading areas were not recalled as well (mean score, 1.4).

The participants' masked recall scores for the warning were significantly associated with total viewing time of the warning ($r = .252$, $P < .001$). An increase in this score was also associated with both the warning "looking" time ($r = .232$, $P < .001$) and the warning "reading" time ($r = .211$, $P < .005$).

As indicated in Table 5, there was a significant association between the participants' smoking status and their masked recall score for both the pack

and heading. The relationship between smoking status and the recall of the warning was not significant, but the trend was in the expected direction.

In the final phase of the study, the participants were asked to choose five actual warnings from a list that also included five simulated warnings (Table 2). The five actual warnings were those that participants had viewed earlier in the advertisements. The possible score on this aided recognition test ranged from 0 to 10. Random guessing would have led to an average score of 5. For the 61 study participants, the mean aided recognition score was 7.25 ± 1.59. The score on the this test was significantly associated with the warning "looking" time ($r = .167$, $P = .025$) and the "reading" time ($r = .158$, $P = .025$). The aided recognition score was negatively associated with age ($r = -.273$, $P < .001$) (Table 6). This score was also associated with smoking status (non-

Table 6.—Warning Recall Score by Age (N = 61)

Age, y	Surgeon General's Warning Aided Recall*
13 (n = 7)	8.00 ± 1.08
14 (n = 17)	7.53 ± 1.47
15 (n = 14)	7.33 ± 1.00
16 (n = 12)	7.14 ± 1.26
17 (n = 11)	6.36 ± 2.41

* $r = .273, P < .001$.

smokers, 7.27; experimenters, 6.91; regular smokers, 8.0; $P < .0001$).

COMMENT

It has been eight years since Blum²⁸ first drew attention to the potential harm of tobacco advertising. Since then, several types of evidence have associated tobacco advertising with adolescent smoking.^{16,17,20} These studies indicate that adolescents and even very young children are aware of the specific content of tobacco advertisements. In one study, 30% of British 6-year-old children were able to identify that an advertisement was for cigarettes even though it contained no smoking clues.¹⁶ Another study has shown that adolescent recognition of tobacco advertising is closely associated with individual smoking status.¹⁷ A stronger causal relationship between smoking and advertising will not likely be established since it would be unethical to examine this association in an experimental study and impossible in an observational study to isolate the advertising effect from the multiple confounding factors in the environment. Nevertheless, a strong case can now be made that the advertising of tobacco products contributes to the initiation and maintenance of tobacco habits.^{6,10,20}

The federally mandated tobacco warnings were designed to serve as a health message to tobacco users and potential users of these products.²⁰ There are indications that the warning may be ineffective among teenagers, the group from which nearly all new smokers are recruited. The most telling of these indicators is the fact that adolescents greatly underestimate the health consequences of smoking.^{12,21} A recent study has shown that 44% of adolescents either experiment with or regularly use tobacco products.²²

The issue of the warning's effectiveness plays a prominent role in the liability of cigarette manufacturers for the injuries incurred by persons using their products. The importance of liability litigation as a cancer-control strategy has been recently reviewed.⁴

Despite its potential importance as a health education message and its central role in the current liability debate,

there have been few studies examining the effectiveness of the warnings. In 1981, the FTC published a report on cigarette advertising that did discuss this issue.⁷ The FTC staff claimed that the original warning was probably ineffective because it was (1) overexposed and worn-out; (2) no longer novel; (3) abstract and therefore difficult to remember; and (4) not likely to be perceived as personally relevant. Most of the data relating to the warning's effectiveness were omitted from the published FTC report because of its "confidential" nature.

The federally mandated warning is a small, colorless, cognition-based message that is usually at the periphery of an advertisement. This placement is under the control of those preparing the advertisements for tobacco manufacturers. The warnings compete with large, colorful, image-based messages within the advertisement that relate smoking to romance, athletic success, excitement, and fun. The warning's effectiveness must be measured within the environment of the total advertisement and compared with the effectiveness of the image-based advertising message with which it competes.

We employed well-accepted market research techniques to examine the viewing of tobacco advertisements by adolescents. These included studies of eye tracking, the recall of masked areas of the advertisements, and an aided recognition test for the Surgeon General's warnings. While largely unknown within the medical literature, these methods are frequently employed by market researchers in the development of print advertisements.^{19,22,23} Eye tracking data are considered to be some of the most valid measures of the acquisition of information.²³ Only those informational elements that are visually fixated on can be picked up and transferred to the short-term memory. The recognition and recall testing then measures the extent of the processing and retention of the information picked up.²³

In the eye tracking study, the adolescent subjects viewed tobacco advertisements for an average of 8.95 s, of which only 0.75 s was spent viewing the warning. In nearly half of the cases, subjects failed to even look at the warning. In 36.7% of cases there was reading of the warning but the mean duration of the total reading time was only 0.23 s. This is sufficient time for a reader of average speed to read only about one third of the words in the warning.²³

Of interest is the mean viewing time for the Red Man warning (0.616 s). This warning's shape is an arrow into a circle. This shape was dictated by legislation in

1986 after the 1981 FTC report indicated that it might lead to higher visibility than the rectangular warnings already in use.⁷ Within the visual environment of the Red Man advertisement that was used in this study, this shape did not elicit a high level of eye fixation. In the masked recall study, this warning also generated a significantly lower mean recall score than the other four warnings ($P < .001$).

The masked recall scores indicate that adolescents are more likely to identify the pack than either the heading or the warning. Tobacco advertising is principally picture and image based; therefore, it is hardly surprising to find that the worded elements in the advertisements were not remembered as well.

Seventy-four percent of participants were able to identify the masked warning as a health message but only 19% were able to recall even the warning's general theme. Of interest was the fact that the mean recall score for the warning was higher than that of the heading. We believe this is because subjects were able to recognize the masked warning's size, shape, and peripheral location on the page.

For the masked recall scores, a statistically significant dose-response relationship was seen between smoking status and recall for both the pack and the heading. This association has been identified previously in adolescent populations in the United States, Australia, and Great Britain.^{15-18,20} In contrast, the recall of the warning, while in the same direction, was not significantly associated with smoking status. This suggests a different degree of interaction between the participants' smoking status and the body of the advertisement compared with smoking status and the warning.

Despite the fact that Americans regularly observe tobacco warnings in their environment (ie, in newspapers and magazines and on billboards), the aided recognition data indicate that the adolescents in this study were unable to reliably identify actual warnings. Scores on this aided recognition test were lower for older adolescents and for those who experimented with tobacco products. This may reflect cognitive dissonance by those adolescents who experiment with tobacco. Previous research has indicated that both heavy and light smokers tend to discount the negative impact of smoking.²⁴

The warnings used in the tested advertisements averaged 3.2% of the total space on the advertisement page. It might be expected that more regular viewing of the warning would occur if warnings were larger or were better

integrated into the advertisement. Research on warning disclosure for prescription drugs has shown that risk information could be more successfully processed by consumers if the information was integrated into the advertising message.³⁵

Some subjects looked at the warning but failed to fixate long enough for reading to occur. Image-based warnings, like the skull and crossbones seen on poison products, are more likely to be effective than written warnings when viewing is only for short periods of time. Iceland has employed a series of image-based warnings on its tobacco products.³⁶

An alternative option to increase the warning's effectiveness might be to mandate freestanding counteradvertising. Such counteradvertising would have the advantage of not directly competing within the context of tobacco advertisements.

The results of this study should be interpreted in light of several obvious limitations. First, the study population was small and had not been selected to be representative of all adolescents. The complexity of psychophysiological advertising measurements tends to limit sample size. In one review of this type of market research, samples ranged from six to 48 subjects.³⁷ Further work

will be required to validate this study's results using other populations.

Second, it is obvious that the study design produces some artificiality in terms of advertisement exposure. We attempted to minimize this by not telling the participants at the time of the advertisement viewing that they would be questioned later about the advertisement's content. Nonetheless, it is probable that the advertisements were studied in more detail than would occur during the routine viewing of a magazine. It is therefore likely that, in normal situations, the viewing time of the warning is much shorter. This strengthens the major conclusions of the study.

We have chosen fixations of 0.10 s as representative of reading behavior. There is evidence that the shortest fixation for reading comprehension is 0.20 s.³⁸ If this more generous fixation time were to be used, then only 18% of warnings would have been classified as having been read at all. The minimal fixation time required to read the Surgeon General's warning is unknown. It is, however, likely to depend on the complexity of the worded message, the reader's educational level, as well as previous exposure to the warning.³⁹

Finally, the masked recognition and aided recall tests suffer from environmental contamination. Tobacco warn-

ings are the most frequently encountered health messages in America. It is impossible with the present design to separate the effect of prior exposure from the exposure during the study viewing. The high level of previous environmental exposure to tobacco warnings makes the low recognition and recall scores observed in this study all the more alarming.

In conclusion, our data indicate that adolescents often do not see the warning in tobacco advertisements. Even when seen, there is little, if any, reading of the warning. In addition, adolescents are unable to recall the content of observed warnings or to correctly recognize warnings from a list. If the warnings are not seen, or are seen but not processed, they are extremely unlikely to be effective in countering the promises of power, romance, and fun implied by tobacco advertisements.

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