Exposure to Televised Alcohol Ads and Subsequent Adolescent Alcohol Use

Alan W. Stacy  
Claremont Graduate University

Jennifer Zogg  
University of Southern California

Jennifer Unger  
University of Southern California

Clyde W. Dent  
University of Southern California

Recommended Citation
Objective: To assess the impact of televised alcohol commercials on adolescents' alcohol use. Methods: Adolescents completed questionnaires about alcohol commercials and alcohol use in a prospective study. Results: A one standard deviation increase in viewing television programs containing alcohol commercials in seventh grade was associated with an excess risk of beer use (44%), wine/liquor use (34%), and 3-drink episodes (26%) in eighth grade. The strength of associations varied across exposure measures and was most consistent for beer. Conclusions: Although replication is warranted, results showed that exposure was associated with an increased risk of subsequent beer consumption and possibly other consumption variables.

Key words: alcohol, advertising, adolescence, longitudinal

Am J Health Behav. 2004;28(6):498-509

The prevalence of alcohol use increases dramatically during the middle school years. The most rapid increase in prevalence occurs between 12 and 15 years of age. The present study investigates one of the many possible precursors of this problem health behavior by evaluating the hypothesis that exposure to alcohol commercials in youth predicts subsequent drinking.

Most research on this issue has not been prospective. When prospective findings have been available, interpretation still has not always been clear-cut. In one important longitudinal study, recall of alcohol commercials predicted later beer consumption in male but not female youth. However, no reports were provided on effects adjusting for previous levels of alcohol consumption in these data. In a second important longitudinal study from the same population, liking of alcohol advertising and brand allegiance were found to predict later alcohol consumption in young adults, adjusting for effects of previous alcohol consumption. However, liking for alcohol commercials and brand preference could imply product liking, exposure to others who drink, or intentions for future behavior that promote future alcohol consumption, without implying that alcohol commercials themselves influence consumption.

A scientific approach to this topic must explicitly address fundamental methodological issues in assessment, confounding, and alternative interpretations. Only then can public health policy be shaped by reasoned arguments, one way or the other. Regarding assessments of exposure to alcohol commercials, traditional exposure assessments may be limited in findings, if the measures assess different common method-related variables. Another related focused attempt at confounding of exposures with such efforts, intential effects of exposure on consumption may be improved substantial such an attempt would vestite hypotheses.

Addressing FundaPrerequisites for I

There has been m al assessments of exposure to alcoh commercials, a central i. The present study uses assessments as predic pattern of findings and takes into accountings and limitations of interpreting the pattern authors focus on this than alternatives on rationale for multiple present approach avoids heterogeneous constrit scales or factors, interpretation of the sure factors difficult; th another uses assessment s and likely biases.

This study's multipi lems can be classified based and memory-opportunity-based measures' self-reported increase their likelihood of alcohol advertisements TV programs that con
drs and
Use
r. PhD

The strength of
and was most con-. Conclusions: Al-
tion is warranted,
that exposure was
an increased risk
beer consumption
other consumption
alcohol, advertise-
see, longitudinal
av. 2004;28(6):498-509

s been clear-cut. In one
inal study, recall of al-
als predicted later beer
male but not female
reports were provided
for previous levels of
on in these data. In a
longitudinal study from
tion, liking of alcohol
brand allegiance were
later alcohol consump-
ts, adjusting for effects
of consumption. How-
cohl commercials and
ould imply product lik-
others who drink, or
ure behavior that pro-
hol consumption, with-
t alcohol commercials
nce consumption.
reach to this topic must
fundamental method-
assessment, confounding
interpretations. Only
alth policy be shaped by
ts, one way or the other.
ents of exposure to
alcohol commercials, there are simply no
"gold standards." The primary difficulty
with exposure assessments involves in-
tertwined problems of construct validity
and confounding. That is, existing exposure
assessments may assess something else
in addition to, or instead of, exposure
alcohol commercials, underlying any
apparent effects on consumption over
ime. One recourse is to evaluate the
predictive effects of multiple measures of
exposure, varying in assessment method.
Systematic biases in assessment (con-
found ing) may be limited across a pattern
of findings, if the methods of exposure
assessment differ enough to minimize
common method-related (systematic) bi-
ases. Another related strategy is a more
focused attempt at adjusting for likely
confounders of exposure assessments.
With such efforts, inferences about po-
tential effects of exposure to alcohol com-
mmercials on consumption in youth may
be improved substantially. At minimum,
such an attempt would contribute by in-
vestigating previously untested alterna-
tive hypotheses.

Addressing Fundamental
Prerequisites for Inference

There has been much debate about
assessments of exposure to alcohol com-
mmercials, a central issue for inference.
The present study uses multiple, distinct
assessments as predictors, examines the
pattern of findings across assessments,
and takes into account the different mean-
ings and limitations of the measures in
interpreting the pattern of findings. The
authors focus on this approach rather
than alternatives on the basis of the
rationale for multiple methods of assess-
mment as well as on Strickland’s criticism
of some other available approaches. The
present approach avoids combining fairly
heterogeneous constructs into com-
posite scales or factors, which can make
interpretation of the meaning of exposure
factors difficult; the present approach
also uses assessments differing in meth-
ods and likely biases.

This study’s multiple exposure assess-
ments can be classified as opportunity-
based and memory-based measures. Op-
portunity-based measures assess adoles-
cents’ self-reported behaviors that in-
crease their likelihood of being exposed to
alcohol advertisements, such as viewing
TV programs that contain numerous al-
cohol advertisements. Most memory-
based measures, in contrast, assess ado-
lescents’ recall or recognition of specific
elements of specific alcohol advertise-
ments or their memory of seeing alcohol
advertising in general.

One type of opportunity-based measure
focuses on exposure to television pro-
grams that show alcohol commercials.
One influential example addresses view-
ing of televised sports events. Exposure
to televised sports is a promising assess-
ment, but it is not without limitations.
For example, greater exposure could im-
ply a greater interest or participation in
team sports (itself a risk factor for alcohol
use), a greater exposure to drinking role
models in the home who also view
these events, or variation on other possi-
ble third-variables that may co-occur
both with exposure to commercials and
with alcohol consumption. Longitudinal
research needs to investigate third-vari-
able explanations and also use some as-
sessments that do not share the same
limitations.

Another example of a viable opportu-
ity-based assessment is a weighted index
that samples exposure to many differ-
ent types of television programs. View-
ning frequency of television programs is
assessed, and the index weights each
program with respect to the frequency
with which that program showed alcohol
commercials. One of the distinctive fea-
tures of this type of index is that it may
help limit the plausibility of certain alter-
native explanations, such as some of the
third-variable confounders of viewing tele-
vised sports. However, it also is not a
panacea, because any measure of pro-
gram exposure measures only the oppor-
tunity to be exposed to the target com-
mmercials, not verified commercial ex-
posure or processing.

The memory-based assessments of ex-
posure are quite different. Although
memory is sometimes seen as an inter-
mediate (intervening) variable, the
present simpler use of memory tests is
appropriate for a 2-wave prospective anal-
ysis that views different measures of ad-
vertising processing as imperfect indexes
of exposure. The 2 memory tests used in
the present study are based on quite
different methods that each test for
memory and include steps that minimize
false positives. A third memory-based
assessment is best described as an index
Televised Alcohol Ads

of "meta-memory" because it asks respondents to self-report frequency of observations of commercials. Each measure of memory has somewhat different strengths and limitations, but perhaps the most likely limitation of the recall measures concerns false negatives. For example, some respondents may be exposed to ads even though their responses to memory tests do not reveal an ability to name, draw, or recognize specific messages, characters, or scenarios from the ads. The "Method" section outlines additional support for use of various assessments of exposure as well as possible confounders, which also must be investigated.

The present study investigates the effects of televised alcohol commercials on the subsequent use of alcohol in a cohort of adolescent public school students, focusing on 2 time points that are critical for the subsequent use of alcohol in a cohort of seventh-grade students in schools in the Los Angeles area in the spring of 1990. The springtime was not included in the 6-point scale range "every day." As with the index, viewing frequency varied widely across the television programs in the scale, ranging from a low of 0.8 alcohol ads per month (That 70's Show) to a high of 68.9 alcohol ads per month (Behind the Music on VH1). Thus, the weights applied to the respondents' self-reported watching frequencies also ranged from 0.8 to 68.9. The weighted frequency scores were then averaged to create an overall index, similar to the method used by Strickland. The mean score on the weighted index was 15.7, with a standard deviation of 9.6 (median = 14.1, interquartile range = 11.1).

**Measures of Advertising Exposure**

**Watched TV shows index.** Respondents were given a list of 20 popular television series and asked to indicate how many times they watched each program during the past month on a 6-point scale from "never" to "every day." The shows, such as Friends and The Drew Carey Show, were chosen on the basis of the number of advertisements aired on the program during the 6-month interval prior to survey administration and teen audience size per program, as determined by data from Nielsen Media research. Following Strickland's strategy, viewing frequency responses for each show were weighted by the show's average monthly alcohol advertising frequency. For example, if a specific television program showed 3 alcohol ads per month, the respondents' viewing frequency score for this program would be multiplied by 3. The number of alcohol ads aired per month varied widely across the television programs in the scale, ranging from a low of 0.8 alcohol ads per month (That 70's Show) to a high of 68.9 alcohol ads per month (Behind the Music on VH1). Thus, the weights applied to the respondents' self-reported watching frequencies also ranged from 0.8 to 68.9. The weighted frequency scores were then averaged to create an overall index, similar to the method used by Strickland. The mean score on the weighted index was 15.7, with a standard deviation of 9.6 (median = 14.1, interquartile range = 11.1).

**Watched TV sports index.** Because televised alcohol advertising occurs much more frequently during televised sporting events than serial television shows, a separate scale was constructed to reflect exposure to televised sports. Using items adapted from Bloom et al., the present study investigates the effects of televised alcohol commercials on the subsequent use of alcohol in a cohort of adolescent public school students, focusing on 2 time points that are critical for the subsequent use of alcohol in a cohort of seventh-grade students in schools in the Los Angeles area in the spring of 1990. The springtime was not included in the 6-point scale range "every day." As with the index, viewing frequency varied widely across the television programs in the scale, ranging from a low of 0.8 alcohol ads per month (That 70's Show) to a high of 68.9 alcohol ads per month (Behind the Music on VH1). Thus, the weights applied to the respondents' self-reported watching frequencies also ranged from 0.8 to 68.9. The weighted frequency scores were then averaged to create an overall index, similar to the method used by Strickland. The mean score on the weighted index was 15.7, with a standard deviation of 9.6 (median = 14.1, interquartile range = 11.1).

**Self-reported freqeuncies adapted from Sel used to assess self-rep1 exposure to alcohol cor past week, how many have you seen for alc beer, wine, or liquor?"; did you see a beer con the last 6 months?"; and did you see wine or liq TV?" Responses were Likert-type scales. Th items represented the 1 (Cronbach's alpha = .79). Because with the index, viewing frequency varied widely across the television programs in the scale, ranging from a low of 0.8 alcohol ads per month (That 70's Show) to a high of 68.9 alcohol ads per month (Behind the Music on VH1). Thus, the weights applied to the respondents' self-reported watching frequencies also ranged from 0.8 to 68.9. The weighted frequency scores were then averaged to create an overall index, similar to the method used by Strickland. The mean score on the weighted index was 15.7, with a standard deviation of 9.6 (median = 14.1, interquartile range = 11.1).

**Cued-recall memory**

most common measure of an advertisement's ability to have been aired within the past 6 months. The remaining 4 commercials consisting of 3 ads (beverage commercials on television) were chosen on the basis of the number of advertisements aired on the program during the 6-month interval prior to survey administration and teen audience size per program, as determined by data from Nielsen Media research. Following Strickland's strategy, viewing frequency responses for each show were weighted by the show's average monthly alcohol advertising frequency. For example, if a specific television program showed 3 alcohol ads per month, the respondents' viewing frequency score for this program would be multiplied by 3. The number of alcohol ads aired per month varied widely across the television programs in the scale, ranging from a low of 0.8 alcohol ads per month (That 70's Show) to a high of 68.9 alcohol ads per month (Behind the Music on VH1). Thus, the weights applied to the respondents' self-reported watching frequencies also ranged from 0.8 to 68.9. The weighted frequency scores were then averaged to create an overall index, similar to the method used by Strickland. The mean score on the weighted index was 15.7, with a standard deviation of 9.6 (median = 14.1, interquartile range = 11.1).
in school during their 10th grade courses. Students reared by school, one of 2 factors of individual differences in memory ability. Control-ad product responses were coded yes/no for false positive beer or alcohol responses and summed as a false-positives index (0-4). The measure of individual differences in memory (ie, better memory for advertisements in general) was the number of nonalcohol ads that the respondent identified correctly (0-4).

**Draw-an-Event memory test.** As an alternate form of memory-based ad-recall measurement, we used a series of 3 "draw-an-event" tests in which students were instructed to think of the first TV commercial that came to mind and to draw a sketch of it. Students also were asked to label the product featured in the imagined ad, and the product response words were computer coded as indicating a student's self-report of recalling/remembering to draw an ad for an alcohol product (yes/no) if the words contained variations on the words beer or alcohol and/or beer or alcohol brand names.

Two additional draw-an-event tests instructed respondents to think quickly of the first 2 alcohol commercials that came to mind and draw them. The 2 questions were preceded by the following definition: "The next questions ask about alcohol; does a different one come to mind?" Students circled "yes" or "no." The draw-an-event score was the number of alcohol ads the student could recall (0-3) across the 3 tests. The mean of this scale was 1.64, with a standard deviation of 0.67.

**Measures of Alcohol Use**

**Current alcohol use.** The alcohol use questions were preceded by the following definition: "The next questions ask about drinking alcohol. This includes drinking beer, wine, wine coolers, and liquor such as rum, gin, vodka, or whiskey. For these questions, drinking alcohol does not include drinking a few sips of wine for religious purposes." In line with Kann, adapted from Bloom et al, respondents were asked how frequently they watched televised professional baseball, college and professional basketball, professional soccer and hockey, and ESPN SportsCenter in the last month. Football was not included in the list of sports because the study was conducted in the springtime, not during football season. Respondents rated each of these items on a 5-point scale ranging from "never" to "every day." The Friends and The Drew chosen on the basis of advertisements aired during the 6-month interval administration and teen program, as determined by school, one of 2

**Self-reported frequency.** Three questions adapted from Schoolder et al were used to assess self-reported frequency of exposure to alcohol commercials: "In the past week, how many TV commercials have you seen for alcohol drinks, like beer, wine, or liquor?"; "About how often did you see a beer commercial on TV in the last 6 months?"; and "About how often did you see wine or liquor advertised on TV?" Responses were rated on 7-point Likert-type scales. The mean of the 3 items represented the respondent's score (Cronbach's alpha=.79). The scale mean was 5.05, and standard deviation was 1.68.

**Cued-recall memory test.** One of the most common measures of the memorability of an advertisement is cued recall. Approximately two thirds of the distributed questionnaires contained a memory-based cued-recall measure. Students were shown 13 still pictures of scenes electronically captured from 13 different television commercials. Nine of the commercials were beer commercials known to have been aired with relatively high frequency on programs popular with teens during the 3 to 6 months prior to testing. The remaining 4 commercials were control ads consisting of 3 current soft drink ads (beverage controls) and one nonbeverage product (a product control). For each commercial, respondents were asked to write the type of product being advertised. Product responses were computer coded for variations on the words beer or alcohol (yes/no). A cued-recall index for beer ads was computed as the number of recent beer commercials correctly identified as beer commercials (0-9). The mean of this scale was 2.7 (SD=2.0), and the Cronbach's alpha was .69. Analysis involving the cued-recall index contained 2 additional adjustment (potential confounder) variables in the models outlined below: one for false positive identification of control ads as alcohol ads and the other for individual differences in memory ability. Control-ad product responses were coded yes/no for false positive beer or alcohol responses and summed as a false-positives index (0-4). The measure of individual differences in memory (ie, better memory for advertisements in general) was the number of nonalcohol ads that the respondent identified correctly (0-4).

**Advertising Exposure shows index.** Respondents were asked how frequently they watched televised professional baseball, college and professional basketball, professional soccer and hockey, and ESPN SportsCenter in the last month. Football was not included in the list of sports because the study was conducted in the springtime, not during football season. Respondents rated each of these items on a 5-point scale ranging from "never" to "every day." The Friends and The Drew chosen on the basis of advertisements aired during the 6-month interval administration and teen program, as determined by school, one of 2

**Self-reported frequency.** Three questions adapted from Schoolder et al were used to assess self-reported frequency of exposure to alcohol commercials: "In the past week, how many TV commercials have you seen for alcohol drinks, like beer, wine, or liquor?"; "About how often did you see a beer commercial on TV in the last 6 months?"; and "About how often did you see wine or liquor advertised on TV?" Responses were rated on 7-point Likert-type scales. The mean of the 3 items represented the respondent's score (Cronbach's alpha=.79). The scale mean was 5.05, and standard deviation was 1.68.

**Cued-recall memory test.** One of the most common measures of the memorability of an advertisement is cued recall. Approximately two thirds of the distributed questionnaires contained a memory-based cued-recall measure. Students were shown 13 still pictures of scenes electronically captured from 13 different television commercials. Nine of the commercials were beer commercials known to have been aired with relatively high frequency on programs popular with teens during the 3 to 6 months prior to testing. The remaining 4 commercials were control ads consisting of 3 current soft drink ads (beverage controls) and one nonbeverage product (a product control). For each commercial, respondents were asked to write the type of product being advertised. Product responses were computer coded for variations on the words beer or alcohol (yes/no). A cued-recall index for beer ads was computed as the number of recent beer commercials correctly identified as beer commercials (0-9). The mean of this scale was 2.7 (SD=2.0), and the Cronbach's alpha was .69. Analysis involving the cued-recall index contained 2 additional adjustment (potential confounder) variables in the models outlined below: one for false positive identification of control ads as alcohol ads and the other for individual differences in memory ability. Control-ad product responses were coded yes/no for false positive beer or alcohol responses and summed as a false-positives index (0-4). The measure of individual differences in memory (ie, better memory for advertisements in general) was the number of nonalcohol ads that the respondent identified correctly (0-4).

**Draw-an-Event memory test.** As an alternate form of memory-based ad-recall measurement, we used a series of 3 "draw-an-event" tests in which students were instructed to think of the first TV commercial that came to mind and to draw a sketch of it. Students also were asked to label the product featured in the imagined ad, and the product response words were computer coded as indicating a student's self-report of recalling/intending to draw an ad for an alcohol product (yes/no) if the words contained variations on the words beer or alcohol and/or beer or alcohol brand names.

Two additional draw-an-event tests instructed respondents to think quickly of the first 2 alcohol commercials that came to mind and draw them. The 2 questions were preceded by the following definition: "The next questions ask about alcohol; does a different one come to mind?" Students circled "yes" or "no." The draw-an-event score was the number of alcohol ads the student could recall (0-3) across the 3 tests. The mean of this scale was 1.64, with a standard deviation of 0.67.

**Measures of Alcohol Use**

**Current alcohol use.** The alcohol use questions were preceded by the following definition: "The next questions ask about drinking alcohol. This includes drinking beer, wine, wine coolers, and liquor such as rum, gin, vodka, or whiskey. For these questions, drinking alcohol does not include drinking a few sips of wine for religious purposes." In line with Kann,
current use of beer, wine, and liquor at eighth grade were assessed with the following items, each with same stem: "During the last 30 days, on how many days did you...", "have at least one drink of beer?", and "...have at least one drink of wine or liquor?". In most surveys of high school students and adults, binge drinking is defined as 5 or more drinks on one occasion. Because this study assessed alcohol use in eighth grade, we set a lower criterion of 3 drinks per occasion as a measure of heavy drinking episodes. The question on binge drinking from the Youth Risk Behavior Surveillance Survey was modified to read, "During the last 30 days, on how many days did you have 3 or more drinks of beer or wine or liquor in a row, that is, within a couple of hours?". This modified measure was labeled "3-drink episodes," even though for the lower weight (and hence blood alcohol level) of this age group it is essentially synonymous with binge drinking. The word *drink* was defined in the instructions as a typical serving size. Responses were given as the number of days (0 to 30), but were recoded to binary as 0 vs 1 or more for the present analysis because the distributions were extremely skewed toward zero.

**Prior alcohol use.** Prior use of beer, wine, and liquor, and 3-drink episodes were assessed with 3 indexes containing the full scale responses to the current use items above, plus similar questions about the frequency of alcohol use in the last 6 months and lifetime. Cronbach's alphas were .85 (beer index), .88 (wine/liquor), and .91 (3-drink episodes).

**Measures of Confounders**
In addition to the memory covariates already outlined, psychosocial and behavioral variables that have been associated with advertising exposure and/or alcohol consumption in previous studies were included as covariates. These included general television viewing frequency, participation in team sports, perception of friends' alcohol use, peer approval of alcohol use, intentions to use alcohol, perceptions of adults' alcohol use, gender, ethnicity, and school.

**Follow-up propensity.** Because the students lost to attrition may differ in risk-behavior profiles from those who are followed up successfully, we included a follow-up propensity score as an additional adjustment variable. The propensity score was predicted in a logistic regression from baseline alcohol use and all other confounding variables listed above and is included in all analyses.

**Data Analysis**
To determine the effects of alcohol advertising exposure on subsequent alcohol use, a series of logistic regression models were used. The models predicted each of the three eighth grade current alcohol use variables from: (a) each of the seventh-grade advertising exposure measures alone (the "unadjusted" model); and (b) advertising exposure, prior use, and all potentially confounding variables listed above (confounder adjusted model). A third set of models examined the 2-way interactions between exposure and prior alcohol use, gender, and ethnicity, in the context of the confounder adjusted model. Exposure measures and all confounders with the exception of demographic variables were standardized to a mean of 0 and a standard deviation of 1 to allow for comparison of coefficients across exposure measures.

**RESULTS**
**Prevalence of Alcohol Use**
The prevalence of lifetime and past-month alcohol use is the seventh grade, 16% of reported drinking beer in 15% reported drinking month, and 8% reported in the past month. By prevalence rates had increases for beer, 20% for wine, and for episodes.

**Correlations Among Measures**
Table 2 shows the correlations among the various measures of exposure. Although correlations were statistically modest (all ≤.33), most had unique conceptual distinction, and investigated as separate variables rather than composite indexes.

**Relevance of Potential Confounders**
To assess the relevance of confounders of our exposure measures, we computed the Pears correlation coefficients between each exposure and each set of measures shown in Table 3, with the exception of demographic variables. Correlation coefficients between exposure and each set of unadjusted measures of TV alcohol use were modest, but significant, associations with prior alcohol use (range - .02 to .17),
previous studies were rates. These included viewing frequency, \textsuperscript{10,21} television sports, \textsuperscript{17,22} perceived alcohol use, \textsuperscript{12,13} and school. \textbf{Penetivity}. Because the attrition may differ in cases from those who are usefully, we included a life score\textsuperscript{29} in one variable. The propensity in a logistic relation alcohol use and all variables listed above and all analyses.

The effects of alcohol ad-

on subsequent alcohol gnostic regression models models predicted each of the grade current alcohol n: (a) each of the advertising exposure measures (adjusted model); and (b) exposure, prior use, and all underlying variables listed (adjusted model). A third method the 2-way inter-

exposure and prior alcohol and ethnicity, in the founder adjusted model. es and all confounders n of demographic vari-

alyzed to a mean of 0 deviation of 1 to allow for coefficients across expo-


Alcohol Use

of lifetime and past-

month alcohol use is shown in Table 1. In seventh grade, 16\% of the respondents reported drinking beer in the past month, 15\% reported drinking wine in the past month, and 8\% reported 3-drink episodes in the past month. By eighth grade, these prevalence rates had increased to 18\% for beer, 20\% for wine, and 12\% for 3-drink episodes.

Correlations Among Exposure Measures

Table 2 shows the correlations among the various measures of alcohol advertising exposure. Although some of the correlations were statistically significant, most were modest (all $\leq .33$). Because each measure had unique variance and was conceptually distinct, the measures were investigated as separate independent variables rather than combined into an index.

Relevance of Potential Confounders

To assess the relevance of potential confounders of our exposure measures, we computed the Pearson correlation coefficients between each exposure measure and each set of confounders. As shown in Table 3, with few exceptions the measures of TV alcohol ad exposures have modest, but significant, concurrent associations with prior alcohol use and intentions (range -.02 to .17), peer and familiar adult use (range .00 to .23), peer norms (range .03 to .14), and the activities of general TV viewing and sports participation (range .06 to .44). The cued-recall memory test measure exhibited the least amount of confounding among this set, with 7 of the 13 correlations being nonsignificant.

Males had higher levels of ad exposure as measured by TV sports watching (r=.31) and higher scores on the memory-based exposure measures (r=.23 with cued-recall test, .09 with the draw-an-event test) than those of females. Hispanics appeared to have higher levels of ad exposures than non-Hispanics as measured by all but the draw-an-event memory test (range .09 to .15), whereas non-Hispanic whites had higher levels of ad exposure as measured only by the draw-an-event test (r=.10). Asians tended to have lower levels of ad exposures than others as measured by all but the draw-an-event test (range -.08 to -.15). Other ethnic groups, including multi-ethnic youth, did not show any evidence of differential ad exposures on any of the measures (range -.05 to .03).

Logistic Regressions of Alcohol Use on Advertising Exposure

Odds ratios, confidence intervals, and p-values for ad exposure measures in the various logistic regression models are provided in Table 4. Because the expo-

<table>
<thead>
<tr>
<th>Grade</th>
<th>3-Drink Episodes</th>
</tr>
</thead>
<tbody>
<tr>
<td>7th grade</td>
<td>1919 (85%)</td>
</tr>
<tr>
<td>8th grade</td>
<td>1749 (77%)</td>
</tr>
<tr>
<td>N (%)</td>
<td>151 (7%)</td>
</tr>
<tr>
<td>N (%)</td>
<td>237 (11%)</td>
</tr>
<tr>
<td>N (%)</td>
<td>180 (8%)</td>
</tr>
<tr>
<td>N (%)</td>
<td>272 (12%)</td>
</tr>
</tbody>
</table>

Table 2: Correlations Among Measures of Alcohol Advertising Exposure

<table>
<thead>
<tr>
<th>Measures</th>
<th>Watched TV Shows Index</th>
<th>Watched TV Sports Index</th>
<th>Self-reported Frequency</th>
<th>Cued-Recall Memory Test</th>
<th>Draw-an-Event Memory Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>2250</td>
<td>2250</td>
<td>2250</td>
<td>1433*</td>
<td>817*</td>
</tr>
</tbody>
</table>

Note. Unadjusted correlations appear in the lower half of the matrix. Partial correlations, partialing out the listed confound variables, appear in the upper half of the matrix.

* $P<.05$

a These exposure measures cannot be correlated because they appeared on alternate versions of the questionnaire.
Table 3: Correlations Between Measures of Televised Alcohol Ad Exposures and Potentially Confounding Variables

<table>
<thead>
<tr>
<th>Confounder</th>
<th>Self-reported Frequency</th>
<th>Watched TV Shows Index</th>
<th>Watched TV Sports Index</th>
<th>Cued-Recall Memory Event</th>
<th>Draw-an-Event Memory Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prior Beer Use</td>
<td>.14*</td>
<td>.11*</td>
<td>.08*</td>
<td>.01</td>
<td>.13*</td>
</tr>
<tr>
<td>Prior Wine/Liquor Use</td>
<td>.13*</td>
<td>.09*</td>
<td>.06*</td>
<td>-.01</td>
<td>.11*</td>
</tr>
<tr>
<td>Prior 3-drink episodes</td>
<td>.09*</td>
<td>.07*</td>
<td>.06*</td>
<td>-.01</td>
<td>.10*</td>
</tr>
<tr>
<td>Intentions to Drink</td>
<td>.17*</td>
<td>.13*</td>
<td>.07*</td>
<td>.09*</td>
<td>.14*</td>
</tr>
<tr>
<td>General TV Viewing</td>
<td>.20*</td>
<td>.21*</td>
<td>.08*</td>
<td>.14*</td>
<td>.06*</td>
</tr>
<tr>
<td>Sports Participation</td>
<td>.15*</td>
<td>.17*</td>
<td>.44*</td>
<td>.11*</td>
<td>.10*</td>
</tr>
<tr>
<td>Peer Alcohol Use</td>
<td>.21*</td>
<td>.16*</td>
<td>.10*</td>
<td>.05</td>
<td>.14*</td>
</tr>
<tr>
<td>Adult Alcohol Use</td>
<td>.23*</td>
<td>.12*</td>
<td>.09*</td>
<td>.03</td>
<td>.12*</td>
</tr>
<tr>
<td>Male (vs female) Gender</td>
<td>.02</td>
<td>.00</td>
<td>.31*</td>
<td>.23*</td>
<td>.09*</td>
</tr>
<tr>
<td>White (vs Nonwhite)</td>
<td>-.03</td>
<td>-.02</td>
<td>-.02</td>
<td>-.02</td>
<td>.10*</td>
</tr>
<tr>
<td>Hispanic (vs Non-Hispanic)</td>
<td>-.03</td>
<td>-.02</td>
<td>-.02</td>
<td>-.02</td>
<td>.10*</td>
</tr>
<tr>
<td>Ethnicity</td>
<td>.11*</td>
<td>.15*</td>
<td>.09*</td>
<td>.13*</td>
<td>-.03</td>
</tr>
<tr>
<td>Asian (vs Non-Asian)</td>
<td>-.12*</td>
<td>-.15*</td>
<td>-.08*</td>
<td>-.10*</td>
<td>-.02</td>
</tr>
<tr>
<td>Ethnicity</td>
<td>.01</td>
<td>-.02</td>
<td>-.00</td>
<td>-.01</td>
<td>.00</td>
</tr>
</tbody>
</table>

Note. * P<.05  
* These exposure measures appeared on alternating forms.

When the exposure measures were standardized, the odd ratios represent changes in odds for one standard deviation unit increase, relative to the average exposure.

**Opportunity-based exposure measures.** The watched TV shows exposure index showed a consistent association with subsequent alcohol use across levels of confounder adjustment and types of outcome. In the fully adjusted model, each one standard deviation increase in alcohol advertising exposure as measured by the watched TV shows index was associated with a 44% increase in odds of beer drinking (95% CI=27%-61%), a 34% increase in odds of wine or hard liquor drinking (95% CI=17%-54%), and a 26% increase in odds of 3-drink episodes (95% CI=8%-48%). The watched TV sports index was associated only with subsequent beer drinking in the fully adjusted model (OR=1.41), although the associated liquor use was only (OR=1.18) but did not have strong evidence of confounders. The self-reported frequency of at least weekly consumption showed a different pattern of associations with outcome to the watched TV shows exposure measure and models were not significant.

**Memory based exposure measures.** The self-reported frequency of alcohol TV ads measure showed significant associations with all 3 subsequent alcohol use measures in the unadjusted models (odds ratio range 1.22 to 1.47), but only with subsequent beer drinking in the fully adjusted model (OR=1.21, 95% CI=1.04-1.41), although the associated liquor use was only (OR=1.18) but did not have strong evidence of confounders. The cued-recall measure appeared on alternating forms. The cued-recall memory test showed a different pattern of associations with outcome to the watched TV shows exposure measure and models were not significant.
the fully adjusted model (95% CI=5%-37%) estimated odds per standard units of the association of the association with subsequent alcohol use and confounder-adjusted results (odds ratios in adjusted results ranged from 1.20 to 1.40).

**Table 4**

<table>
<thead>
<tr>
<th>Exposure Measure</th>
<th>Beer Use OR (95%CI) P</th>
<th>Wine/Liquor Use OR (95%CI) P</th>
<th>3-drink Episodes OR (95%CI) P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Watched TV Shows Index</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unadjusted</td>
<td>1.46 (1.30,1.66) &lt; .001</td>
<td>1.34 (1.21,1.47) &lt; .001</td>
<td>1.33 (1.18,1.49) &lt; .001</td>
</tr>
<tr>
<td>Confounder Adjusted</td>
<td>1.44 (1.27,1.61) &lt; .001</td>
<td>1.34 (1.17,1.52) &lt; .001</td>
<td>1.26 (1.08,1.48) .002</td>
</tr>
<tr>
<td>Watched TV Sports Index</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unadjusted</td>
<td>1.22 (1.10,1.35) &lt; .001</td>
<td>1.05 (0.94,1.16) .339</td>
<td>1.14 (1.01,1.28) .028</td>
</tr>
<tr>
<td>Confounder Adjusted</td>
<td>1.20 (1.05,1.37) .006</td>
<td>1.00 (0.88,1.15) .910</td>
<td>1.07 (0.91,1.26) .383</td>
</tr>
<tr>
<td>Self-reported Frequency</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unadjusted</td>
<td>1.47 (1.30,1.66) &lt; .001</td>
<td>1.32 (1.19,1.49) &lt; .001</td>
<td>1.32 (1.15,1.52) &lt; .001</td>
</tr>
<tr>
<td>Confounder Adjusted</td>
<td>1.21 (1.04,1.41) .012</td>
<td>1.18 (0.98,1.32) .081</td>
<td>1.06 (0.89,1.27) .464</td>
</tr>
<tr>
<td>Cued-Recall Memory Test</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unadjusted</td>
<td>1.15 (1.00,1.31) .008</td>
<td>1.13 (0.99,1.29) .059</td>
<td>1.20 (1.02,1.41) .022</td>
</tr>
<tr>
<td>Confounder Adjusted</td>
<td>1.17 (0.97,1.38) .106</td>
<td>1.07 (0.91,1.26) .406</td>
<td>1.17 (0.91,1.44) .109</td>
</tr>
<tr>
<td>Draw-an-Event Memory Test</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unadjusted</td>
<td>1.01 (0.90,1.13) .856</td>
<td>0.99 (0.88,1.10) .862</td>
<td>1.00 (0.88,1.15) .895</td>
</tr>
<tr>
<td>Confounder Adjusted</td>
<td>0.86 (0.75,0.99) .036</td>
<td>0.92 (0.81,1.03) .226</td>
<td>0.91 (0.78,1.06) .265</td>
</tr>
</tbody>
</table>

**Note.**

The most conservative, *a priori* analysis is shown. An anonymous reviewer suggested an analysis of a composite of the 2 opportunity-based measures. Because of Strickland’s concerns about this practice and the lack of strong evidence that they should be combined, the primary analysis did not rely on a composite score. Nevertheless, a supplementary analysis of this composite score showed that it was a significant, positive predictor of all three dependent variables, revealed in both unadjusted and confounder-adjusted results (odds ratios in adjusted results ranged from 1.20 to 1.40).

**Interactions of Advertising Exposure With Gender, Ethnicity, and Prior Alcohol Use**

All potential variations in the level of association between the alcohol advertising exposure measures and subsequent alcohol use across gender, ethnicity, and level of prior alcohol use were tested by entering interaction terms between these variables to the fully adjusted models above. None of the interaction terms were significant, positive predictor of all three dependent variables, revealed in both unadjusted and confounder-adjusted results (odds ratios in adjusted results ranged from 1.20 to 1.40).
significant at P<.10, indicating there was no evidence of reliable variation in the odds ratios reported in Table 4 across these subgroups.

**DISCUSSION**

This study investigated predictive effects of a diversity of measures of exposure to televised alcohol commercials, as well as a host of potential confounders of the association between exposure and adolescent alcohol use. Any possible measure of exposure has some limitations. Thus, the assessment strategy used measures diverging in limitations such as likelihood of false positives and confounding. The present research is one of the most comprehensive prospective studies on this issue to date, because of the range of measures and confounders investigated. Such an approach is necessary for improved inference.

Inferences about effects in any observational study must take into account the overall pattern of findings, as well as limitations and confounders involved in each of the different exposure assessments. First, when predictive effects of exposure on consumption variables were uncovered, it is clear that they occurred primarily for beer consumption and more rarely for wine/liquor consumption and 3-drink episodes. This general pattern is consistent with several observations from the literature. Most televised alcohol commercials are for beer, and beer is a more frequent alcoholic beverage of choice for youth. Also, binge drinking in eighth grade is a relatively rare event.

Both of the opportunity measures of exposure predicted subsequent beer consumption. These measures assessed the likelihood of exposure to alcohol commercials on the basis of television viewing habits targeting either sports events or popular shows weighted by probability of appearance of alcohol commercials. Importantly, the effects of likely confounders of these assessments were adjusted in the analysis, including sports activity and general levels of television viewing. The analysis also adjusted for numerous other confounders, including prior alcohol use, intentions, peer and adult alcohol use, and other variables. Although in some instances the prospective effects of exposure were slightly diminished, they were still statistically significant and similar in magnitude. The same pattern of findings was obtained for the self-reported frequency, meta-memory measure of exposure, with significant prospective effects on beer consumption even when effects of all confounders were adjusted for. Predictive effects of the 2 recall tests of exposure were nearly always nonsignificant in confounder-adjusted analyses, except for one counterintuitive instance in which exposure predicted less beer consumption. In advertising research, memory for specific commercials has a far less than perfect association with brand choice. Less is known about memory for commercials across a product class, although some tests have shown reliability and convergent validity in alcohol advertising research.

One of the exposure measures, the watched TV shows index, showed significant predictive effects on all consumption variables, even when adjusting for all confounders. This index was similar in rationale and design to that first found effective by Strickland. It is important to note that this is an indirect measure that does not ask respondents directly about alcohol commercials. It merely assesses frequency of viewing popular television programs and weights these scores by the number of commercials shown on these programs. It is hard to explain a predictive effect of this variable through such alternative explanations as hypothesis guessing or demand characteristics. It is also difficult to imagine more proximal confounders of this relationship that were not already controlled for in the analysis, such as previous use, intentions, peer use, adult use, or general television viewing.

Another feature of the general pattern of results is that a great majority of the odds ratios were positive, even though most for wine and liquor consumption and 3-drink episodes were not significant. Taken together, the findings argue for effects on beer consumption and trends toward effects on wine and liquor consumption and 3-drink episodes in most comparisons. This is a somewhat mixed picture, but nevertheless it leans toward the view that alcohol commercials have some effects on alcohol consumption in this age group.

In the confounder-adjusted model, the draw-an-event memory was associated with a lower odds ratio of subsequent monthly beer drinking. Although speculative, one possibility is that memory is more assessment. In addition verbal images of reme the test may engage the test itself, image-based elation of the commercial—who provide sketches of content in some preventive effects in the bal processing and more fundamental area of b search and cognitive n is very seldom applied t or prevention. Because ifive effects were not c hand in the present su been evaluated in previc post hoc explanation s cred tentative but worth future research.

These results should context of several limitent study. First, it is pr for any observational st very possible confound plain away effects of al Tho the major limite n design. Altho believe that most unm would have operated t founders that were ass search might evaluate ties. For example, futu assess adolescents' prosocial extracurricular general, which may be fewer opportunities to w ciated with a lower ris however, at least one t volvement in sports) wa present study. Similar tivities or general prope ancer (problem pronen considered in future i though these variables testes in our confounde alcohol use, intention watched); in any case, deviance and alcohol sure has not been dem tively to our knowledge. confounding variables here include depression monitoring practices, likely to be mediated a in the confounder TV watched) if they hav sure. The present study
obtained for the self-re-
meta-memory measure
a significant prospective con-
sumption even when founders were adjusted
for on the 2 recall tests
were nearly always
a confounder-adjusted
for one counterintuitive
exposure predicted less
on in advertising re-
for specific commercials
han perfect association
Less is known about
commercials across a product
some tests have shown
s divergent validity in alco-
posure measures, the
s index, showed signifi-
cant effects on all consumption
when adjusting for all
s index was similar in
sign to that first found
It is important to
in indirect measure that
pondents directly about
als. It merely assesses
ving popular television
ghts these scores by the
itals shown on these
rd to explain a predictive
ble through such alter-
als as hypothesis guess-
characteristics. It is also
ne more proximal con-
relationship that were
led for in the analysis,
. use, intentions, peer
. general television view-
re of the general pattern
a great majority of the
positive, even though
liquor consumption and
were not significant.
the findings argue for
consumption and trends
wine and liquor con-
drink episodes in most
s is a somewhat mixed
therwise it leans toward
cohol commercials have
cohol consumption in
nder-adjusted model, the
memory was associated
d s ratio of subsequent
king. Although specu-
lative, one possibility is that this nonver-
bal sketch test is more than a memory
essment. In addition to revealing non-
val images of remembered scenes, the
test may engage the student in ben-
ficial, image-based elaborative process-
ing of the commercial—that is, students
who provide sketches of an ad may pro-
process its content in some ways that have
preventive effects in the future. Nonver-
bal processing and memory constitute a
fundamental area of basic memory re-
search and cognitive neuroscience that
is very seldom applied to health behavior
or prevention. Because links to prevent-
effects were not considered before-
hand in the present study and have not
been evaluated in previous research, this
post hoc explanation should be consid-
ered tentative but worthy of evaluation in
future research.

These results should be judged in the
context of several limitations of the cur-
rent study. First, it is probably impossible
for any observational study to assess ev-
every possible confounder that might ex-
plain away effects of assessed exposure.
This is the major limitation of an observ-
ational design. Although the authors
believe that most unmeasured variables
would have operated through the con-
founders that were assessed, future re-
search might evaluate several possibili-
ties. For example, future studies might
assess adolescents' involvement in
prosocial extracurricular activities in
general, which may be associated with
fewer opportunities to watch TV and asso-
ciated with a lower risk of alcohol use;
however, at least one type of activity (in-
volvement in sports) was assessed in the
present study. Similarly, antisocial ac-
tivities or general propensity toward devi-
ance (problem proneness) needs to be
considered in future investigations, al-
though these variables also may be mani-
fested in our confounder set (eg, previous
alcohol use, intentions, hours of TV
watched); in any case, the link between
deviance and alcohol commercial ex-
posure has not been demonstrated prospec-
tively to our knowledge. Other potentially
confounding variables uncontrolled for
here include depression and parental
monitoring practices, which also are
likely to be mediated through the vari-
able in the confounder set (eg, hours of
TV watched) if they have effects on ex-
posure. The present study did adjust for the
strongest known longitudinal predictors of
future alcohol consumption, including
previous consumption, peer use, inten-
tions, and other proximal variables that
should at least partially index the omitted
variables.

Second, the study is limited in
generalizability, because the sample is
only from adolescents in public school
from only one region of the United States.
Compared with the overall US population,
this sample was more ethnically diverse
and contained a larger proportion of His-
panic students. Nevertheless, the com-
plete absence of interactions of obtained
effects with major demographic variables
such as gender and ethnicity shows the
results are generalizable at least across
some diverse groups. Third, these find-
ings are based on adolescents' self-re-
ports of alcohol use; biochemical valida-
tion was not conducted. Finally, although
the results show some consistent pat-
terns, not all measures of exposure con-
verge on the same findings. This was
particularly true of the differences in
findings between the memory-based mea-
sures and the opportunity-based mea-
sures. The present state of the validation
literature on exposure assessment does
not show which tests are optimal. Al-
though the limited generalizability of the
sample and inherent uncertainties in
observational designs imply that results
should be replicated, the present findings
are consistent with conclusions from pre-
vious longitudinal studies.

Effects of advertising have implications
for the prevention of alcohol use among
adolescents. Although alcohol marketing
efforts ostensibily target an adult audi-
cence, these findings indicate that young
adolescents have numerous opportuni-
ties to view alcohol advertisements on
television; and youth do notice and recall
these advertisements. Furthermore, ad-
olsons who are exposed to alcohol ad-
vertised may have a higher risk of experimen-
ting with alcohol in subsequent
years. Although the magnitude of the
association between alcohol-ad exposure
and alcohol use varied according to the ad
exposure measure used, the weight of the
evidence from this study is consistent
with that of some other studies suggest-
ing that exposure to alcohol advertising
increases the risk of subsequent alcohol
use. Even if the risk attributable to
advertising is small relative to other in-

Am J Health Behav.™ 2004;28(6):498-509

Stacy et al
fluences such as peers and social norms, limiting adolescents’ exposure to proalcohol media messages could be an important part of a comprehensive strategy to prevent adolescent alcohol use. Given the potential public health benefits of reducing adolescent alcohol use, increased attention to this issue is warranted.

Acknowledgments
This research was supported by grant AA 12128 from the National Institutes of Health. We thank Nielsen Media Research for providing information on alcohol commercials shown during specific television programs and the viewing ratings of those programs.

REFERENCES
30. Center for Science in the the Beer Tax Rollback


