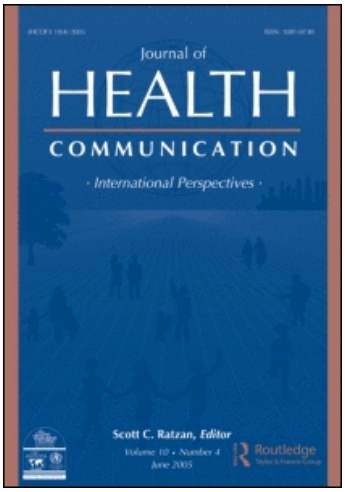

Journal of Health Communication
Publication details, including instructions for authors and subscription information:
http://www.informaworld.com/smpp/title~content=t713666566

Influence of a Nationwide Social Marketing Campaign on Adolescent Drug Use

Lawrence M. Scheier [a];Jerry L. Grenard [b]
[a] LARS Research Institute, Inc. and Washington University School of Medicine, Department of Psychiatry, Epidemiology and Prevention Research Group, St. Louis, Missouri, USA [b] Department of Health Services Research, School of Public Health, University of California, Los Angeles, California, USA

Online publication date: 27 April 2010

To cite this Article Scheier, Lawrence M. andGrenard, Jerry L.(2010) 'Influence of a Nationwide Social Marketing Campaign on Adolescent Drug Use', Journal of Health Communication, 15: 3, 240 — 271
To link to this Article: DOI: 10.1080/10810731003686580
URL: http://dx.doi.org/10.1080/10810731003686580

Journal of Health Communication, 15:240–271, 2010

ISSN: 1081-0730 print/1087-0415 online
DOI: 10.1080/10810731003686580

Routledge
Taylor & Francis Group

Articles

Influence of a Nationwide Social Marketing Campaign on Adolescent Drug Use

LAWRENCE M. SCHEIER

LARS Research Institute, Inc. and Washington University School of Medicine, Department of Psychiatry, Epidemiology and Prevention Research Group, St. Louis, Missouri, USA

JERRY L. GRENARD

Department of Health Services Research, School of Public Health, University of California, Los Angeles, California, USA

In this study, we examined whether awareness (recall) of the National Youth Anti-Drug Media Campaign (NYADMC) benefited youth by attenuating their drug use. Data were obtained from the National Survey of Parents and Youth (NSPY), an evaluative survey tool designed to monitor campaign progress over 4 years. A growth modeling strategy was used to examine whether change in message recall or campaign brand awareness was related to declining patterns of drug use. Two distinct growth trajectories were modeled to account for growth among younger (12 to 14) versus older (15 to 18) youth. Growth trajectories indicated steady and positive increases in alcohol, cigarette, and marijuana use over time. During the early portion of adolescence, youth reported more "brand" awareness, remembered more of the video clips depicting campaign messages, recalled more media stories about youth and drugs and more antitobacco ads, and reported more radio listening and less television watching. When they were older, these same youth reported declines in these same awareness categories except for specifically recalling campaign ads and radio listening. Models positing simultaneous growth in drug use and campaign awareness indicated mixed findings for the campaign. Overall early levels of campaign awareness had a limited influence on rates of growth, and in a few cases higher levels were associated with quicker acquisition of drug use behaviors. When they were younger, these youth accelerated their drug use and reported increasing amounts of campaign awareness. When they were older, increasing awareness was associated with declines in binge drinking and cigarette smoking. No effects for marijuana were significant but trended in the direction of increased awareness associated with declining drug use. The findings are discussed in terms of how they depart from previous reports of campaign efficacy and the potential efficacy of social marketing campaigns to reach a large and impressionable youthful audience with strategically placed advertisements.

Address correspondence to Lawrence M. Scheier, LARS Research Institute, Inc., 11735 Glowing Sunset Lane, Las Vegas, NV 89135, USA. E-mail: Scheier@cox.net

The National Youth Anti-Drug Media Campaign (NYADMC) is a concerted response by the federal government to deter adolescent drug use. The campaign targets youth in the early part of adolescence, when they are most vulnerable to drug initiation proffering a bevy of media communication strategies showcasing the personal and social pitfalls of drug use. Prior reports of campaign efficacy suggest that awareness of campaign messages was associated with higher drug use among teens, underscoring a "boomerang" or iatrogenic effect (Hornik, 2006; Hornik, Maklan, Cadell, et al., 2003; Orwin et al., 2006). This can be disappointing, especially since evidence is accruing that social marketing campaigns designed around persuasive health messages may be effective tools to obtain behavior change (e.g., Brown & Einsiedel, 1990; Flay & Burton, 1990; Pechmann & Reibling, 2000; Zucker et al., 2000). In this article, we explore several limitations with previous analyses that may mask or hide campaign efficacy. We then present a brief overview of the campaign history including discussion of its theoretical background. This is followed by presentation of new campaign evaluation findings using alternative modeling strategies that capture the dynamic interplay of campaign exposure and its influence on youth drug use.

The National Youth Antidrug Media Campaign

The campaign ran in its initial format as "The Anti-Drug" from 1999 to 2004 and incorporated state-of-the-art social marketing technology aimed at reducing adolescent initiation of drug use and to curtail use among those already engaged.[1] In the period leading up to implementation of the campaign, various drug surveillance systems pointed to consistently high drug prevalence rates among our nation's secondary school students (Johnston, O'Malley, Bachman, & Schulenberg, 2007) as did data from a nationally representative household survey (Substance Use and Mental Health Services Administration, 2007). This surveillance information coupled with the increasing number of new initiates to drug use sounded an alarm for Congress to institute more powerful, sustainable, broad-brush prevention campaigns. In 1998 Congress appropriated funds to conduct a scientifically rigorous and independent evaluation of the NYADMC. A signature event of the campaign included implementation of a new nationally representative, household-based survey, the National Survey of Parents and

[1]Historically speaking, much of the "technology" of social marketing is based on the work of Lazarsfeld and Merton (1949) and Wiebe (1951–1952) and later refined by Kotler and Zaltman (1971; Kotler & Roberto, 1989). Social marketing campaigns use "brand" merchandising to sell or market social behavior change in a similar fashion as product marketing. In brand marketing schemes, information about a product is transmitted with the goal of changing behavior and increasing product consumption. Social marketing represents a variant of brand or commodity marketing, with the goal of persuasively changing behavior through value or attitudinal change. Standard campaign applications of these ideas generally have relied on public service announcements (PSAs) and ancillary communication strategies (e.g., television, radio, print media, billboards) to inform the public with a goal of changing beliefs, attitudes, and eventually behaviors. If diffusion of information about a product through merchandising will increase buying behavior, then transmission of information about social values may very well encourage people to change their behaviors. Examples of mass media interventions include campaigns to reduce cigarette smoking among youth (Flynn et al., 1992; Murray, Prokhorou, & Harty, 1994; Popham et al., 1994; Siegel & Bierner, 2000), reduce sexual risk, HIV and AIDS (e.g., Farr, Witte, Jarato, & Menard, 2005; McCombie, Hornik, & Arnarfi, 2002), child abuse (e.g., Stannard & Young), heart disease (Belicha & McGrath, 1990), and nutrition (Chew, Palmer, & Kim, 1998), to name a few.

Youth (NSPY), which could be used to assess youths' awareness of the campaign messages and monitor any corresponding changes in drug use trends.

Detailed information on the phased staging of the campaign and the pro-bono match conducted with the entertainment industry can be found in various reports issued by the Office of National Drug Control Policy (ONDCP, 1998) and the evaluation contractor (Orwin et al., 2005).[2] From a conceptual point of view, the campaign messages were fairly broad and inclusive for all ages; however, the evaluation component emphasized tracking responses in youths between 11 and 14 years of age. These are the critical years when drug influences by peers are most active and also reflect the formative years of identity formation when youth are most vulnerable to certain risk behaviors (Hawkins, Catalano, & Miller, 1992). In the latter stages of the campaign, owing to nationwide upturns in marijuana use, the Marijuana Initiative was put into motion. The Initiative shifted the target group from 11 to 14 years of age over to 14 to 16 years as the primary audience. With this change in emphasis, almost 99% of the campaign ads focused exclusively on the negative and damaging social, legal, economic, health, and academic consequences of marijuana use.

Theoretical Background for the Media Campaign

To place the campaign in perspective, the main thrust of the campaign advertising emphasizes that most youth do not use drugs (prevalence themes), that drugs interfere with life's ambitions, and have deleterious effects on social status impeding success in life (consequence themes). Drugs are depicted as a bad choice that interferes with normal role socialization, disrupts social relations, and encourages risky behavior and deviant adaptations. Many of the campaign PSAs and radio commercials depict drug-using youth as "loners" and disenfranchised from mainstream conventional institutions (school, family, peers). Youth are encouraged to refuse drug offers (again emphasizing marijuana in most of the advertisements) and are reminded how effective these skills are to offset a wide range of negative social influences. Behavior change is guided by the Theory of Reasoned Action (TRA: Ajzen & Fishbein, 1973, 1977) and draws also from social persuasion (McGuire, 1961, 1966, 1968) and communication theories (Hovland, Janis, & Kelley, 1953). According to the TRA, the influence of attitudes (i.e., subjective evaluations of behavior consequences) and beliefs (subjective norms and behavioral outcomes or expectancies) on behavior is mediated through intentions (i.e., future intent to engage the behavior). In other words, youth form impressions of whether drugs are good or bad, and they combine this information with normative beliefs (whether their close friends approve of drug use) and behavioral expectations (perceived benefits and negative consequences of drug use) toward drug use. These steps are necessary but not sufficient conditions, as the final decision to use drugs is guided by their behavioral willingness or intentions.

Modeling Developmental Change Using Growth Curve Analysis

To date, analyses of the media campaign efficacy have used traditional linear regression or correlation techniques to examine campaign effects. While this tactic

[2]Detailed information on the scope of the media campaign, funding sources, and evaluation can be obtained at www.whitehousedrugpolicy.gov, http://www.drugabuse.gov/DESPR/Westat/ and through the ONDCP site http://www.mediacampaign.org/publications/index.html

has been useful to delineate the basic statistical associations between campaign awareness and drug use, a major weakness of this approach is that it fails to provide a developmental perspective and incorporate systematic features of change in either awareness or drug use. A cornerstone feature of the campaign's success would suggest that increasing amounts of exposure to campaign messages (assessed through measures of awareness and recall) attenuates drug use in those already using and possibly curtails experimentation in novice users. Theoretically speaking, the bevy of campaign messages from various media sources (e.g., television, radio, print media) should have the effect of stifling the desire to use drugs because youth come to realize that drug use is not normative, valued by their peers or society, and can have catastrophic personal effects.

A program evaluation that can appreciate the importance of dose-response relationships (i.e., cumulative exposure to and awareness of the campaign messages over a prolonged period of time reduces drug use) requires analysis of variances and covariances (both within- and between-wave covariance matrix information) in addition to explicit modeling of the mean structure of the data. This analytic framework provides a means to identify features of development from one point in time to another and examine factors associated with the underlying process of "change." Growth modeling is clearly a more definitive way to address the question of change and increasingly has been advocated as a means to assess prevention effects that unfold over time (Brown, Catalano, Fleming, Haggerty, & Abbott, 2005; Mason, Kosterman, Hawkins, Haggerty, & Spoth, 2003; Park et al., 2000; Taylor, Graham, Cumsille, & Hansen, 2000). A growing literature specialized in analysis of change highlights distinct strengths of this approach with respect to modeling development (Duncan & Duncan, 1995; Mehta & West, 2000; Rogosa & Willett, 1985; Willett & Sayer, 1994) and to better understand drug etiology (Duncan & Duncan, 1996; Wills & Cleary, 1999), including studies of alcohol (Curran, Stice, & Chassin, 1997; Scheier, Botvin, Griffin, & Diaz, 2000), cigarettes (Simons-Morton, Chen, Abroms, & Haynie, 2004), and marijuana (Brook, Whiteman, Finch, Morojele, & Cohen, 2000).

There are several distinct features associated with growth modeling that apply to the NSPY data. For one thing, the NSPY collected data from youth ages 12 to 18 (data from youth ages 9 to 11 are excluded from the current study) at each of four rounds. Thus a youth who was 12 in Round 1 was followed three more times through age 15 using follow-up assessments scheduled anywhere from 6 months to 1 year later. Given the purposeful sampling strategy to ensure adequate representation of youths in the critical and vulnerable years (12 to 15), Round 1 of the NSPY evaluation data includes some youth who are 12, some 13, some 14, and so forth through age 18. A natural attrition mechanism was imposed so that youths older than 18 were not tracked longitudinally (for cost efficiency and coinciding with the campaign's focus on the critical formative years of drug initiation). Thus, at each successive round there would be youth anywhere between 12 and 18; however, youth older than age 18 are considered ineligible and therefore not refielded in subsequent waves of data collections (recruitment of new youth at each successive round was also minimized).

The age mixture within each round makes it imperative to estimate growth using age- cohort models (Mehta & West, 2000; Muthén, 2000) to offset the age-based heterogeneity that may arise in the data from true individual differences in the focal constructs. In other words, there may be some variability in drug use (both initial status and rate of growth) and likewise in measures of campaign awareness that arguably

arises from differences in the ages of the respondents within each data collection point. To illustrate this point, younger non-drug-using youth may benefit from the campaign differently from older drug-using youth, for whom the messages have little traction. Technically speaking, where a youth starts in the process (with respect to either drug use or awareness) and how fast they grow is age dependent. From an analytic point of view, the underlying heterogeneity of age requires developing model parameters that reflect the individual vectors of growth in addition to accounting for population or aggregate trends (i.e., the random effects portion of the model that posits a between-persons effect of age). Using an age-cohort approach with time-structured data, we then can ask more specific questions about how each of the various age groups fared with respect to their campaign awareness, and not restrict ourselves to asking whether all youth in general responded to the campaign messages.

There are several ways to parameterize a model of this nature (see, for example, Duncan, Duncan, & Strycker, 2006); however, in the model we propose, age replaces a measure of time as the main chronometric consideration, and the various components of the growth model become conditioned on age rather than being focused on time (the successive rounds). With this rescaling of time in terms of age, the model now addresses how change in awareness influences change in drug use as if all the youth were present at each of the ages sampled. That is, if a youth was 13 at Round 1 and did not start the study at age 12, his or her missing data for age 12 is treated as missing at random and augmented using full information maximum likelihood estimation procedures (Dempster, Laird, & Rubin, 1977; Graham, Hofer, & MacKinnon, 1996; Muthén, 2000). In this situation, the mechanisms behind the missing data are design based rather than being a function of observed covariates or outcomes (i.e., drug use). Even though the data are not available for each individual at the age at which they possibly could be eligible for participation in the study, the programmatic features of an age-cohort model rearrange the data based on age rather than on round or data collection cycle.

A second distinct feature of a growth model is its ability to monitor how change in one construct influences change in another. This type of ''bivariate'' growth model can single out the influence of one slope function or aggregate measure of change on another slope function. In the present study our focus emphasizes whether change in campaign awareness assessed by various recall measures influences trajectories of self-reported drug use. A third feature rests with the specific model parameterization that is used. The standard approach includes an intercept term that captures the reference point before growth is estimated, and this can be realistically used as a baseline status indicator (characterizing the group as a whole). A second growth function, the slope term, is an aggregate profile of all the individual growth trajectories across time. A structural path from the campaign awareness intercept to the slope term for drug use (also called a ''lagged'' effect) tests whether early recall of campaign messages influenced trajectories of drug use (and corresponds to a true ''program'' effect). A structural path from the drug use intercept to the slope of campaign awareness captures the effect of early levels of drug use on growth in recall of campaign messages. This would represent a ''consequence'' effect underscoring that perhaps drug use interferes with receptivity of campaign messages or limits somehow use of the various media channels. In the event this structural component is significant, it could be used to argue that youth who already have experimented with drugs during the early phases of the campaign may not benefit from the campaign messages, a possibility that was not identified before in previous analyses.

One other item that surfaces within the context of the campaign suggests that awareness or recall is not the endpoint or dependent variable as explained above, but it should take shape as a manipulation or independent variable.[3] Testing this conceptualization requires a slightly different model parameterization in which campaign awareness is treated as a time-varying covariate that influences drug use. This model specifies a ''fixed effect'' of awareness for each cohort year (age 12, age 13, age 14, ... 18) on drug use, controlling for the underlying growth in drug use. The model in this analysis asks whether awareness exerts an influence at a particular age even though the underlying trend in drug use may change over time. Even though a randomized prevention trial was not used to assess media campaign effects, we still identified whether manipulating campaign exposure influenced drug use.

Importance of the Present Study

It is clear from this brief overview of the various strengths of growth modeling that the absence of any formal means to test developmental features of the data in terms of age and time may lead to erroneous conclusions regarding campaign effects. In the present study, we explore relations between campaign awareness and three types of drug use that were the principal focus of the media campaign evaluation (alcohol, cigarettes, and marijuana). The inclusion of effects for cigarette and alcohol even with the advent of the marijuana initiative is done simply for two reasons. The gateway hypothesis suggests that early stage drug use follows a progression from alcohol to cigarettes and then to harder illicit drugs like marijuana in an unwavering hierarchical sequence (e.g., Kandel, 2002; Kandel & Faust, 1975; Kandel, Yamaguchi, & Chen, 1992; Newcomb & Bentler, 1986). There is tremendous support for this observation to the extent that most school-based, drug prevention programs emphasize gateway substances as their principal focus (Botvin & Griffin, 2005; Griffin & Botvin, 2009). Because of the closely intertwined nature of drug use experiences in these early stages, it is possible that campaign effects intended for marijuana ''spill over'' to other drugs. Support for this argument also derives from the close association of the risk factors that prompt drug use at this age (i.e., peer social influences instigate early stage drug use as opposed to psychological problems), and how these influences can become bundled together etiologically (Hawkins et al., 1992; Scheier, 2001).

[3]We are deeply grateful to the scholarly review that helped shape the contents of this article. Of the many points raised, one compelling one was the differences between treating awareness as a dependent measure and mapping changes in this measure to concurrent changes in drug use as opposed to treating awareness as if it was a manipulation. The different conceptualizations really attribute to whether we think of the campaign as a randomized trial in which there is a manipulation given equally to every participant. It is conceivable, for instance, that we think of the amount of recall each individual reports as the ''manipulation'' (reflecting their overall exposure), and this was assessed in the NSPY using industry standards as Gross Rating Points (GRPs). At an aggregate (zip code) level, we could measure the effect of GRPs on both recall and drug use, although there was little variation in the amount of campaign shown across the United States. The way we structured our analyses reinforces that the ultimate goal of the media campaign is to test whether the infusion of PSAs and antidrug messages shown through various media channels increases youth awareness that drugs will interfere with normal development and have negative consequences. Toward this end, the growth models express this emphasis by showing whether the trajectories of campaign awareness influence normative drug use trends. The models with awareness as a time-varying covariate express a slightly different and perhaps more experimental view.

Second, an argument can be made that even though the Marijuana Initiative instituted in 2002 (which corresponds to the later part of the campaign evaluation) encouraged youth to refrain from marijuana use, the campaign's original directive fell under the broad catchall of "antidrug" and was not marijuana specific. This is quite pertinent to the evaluation tool, which asked questions about recall of "generic" antidrug messages. The inclusion of nonspecific antidrug messages encouraging youth to avoid drugs and develop drug refusal skills makes it worthwhile to inspect whether campaign messages, even those instituted after 2002, dampened a broad spectrum of youth drug use rather than focusing exclusively on marijuana. Evidence of a broad-brush effect would support social marketing campaigns like the NYADMC, which then can possibly reach a wider audience with concerted antidrug messages.

Method

Overview of the Sample Design

Youth were between the ages of 9 and 18 when they were contacted for participation in the NSPY. Details on the sampling and survey design can be found in several published reports (e.g., Hornik et al., 2003; Orwin et al., 2006). The initial recruitment waves 1–3 comprise Round 1, waves 4 and 5 comprise Round 2 (first follow-up), waves 6 and 7 comprise Round 3 (second follow-up) and waves 8 and 9 comprise Round 4 (third follow-up). Children between the ages of 9 and 11 received a slightly different survey and therefore are not included in the present study. As mentioned previously, ineligible youth older than 18 were flagged and deleted from the panel sample.

Derivation of Sampling and Correction Weights

Individual weighting factors adjusted for the complex sampling design including nonresponse and selection factors. In addition, counterfactual projection (CPF) weights provided adjustments for variables that may be confounded with campaign awareness and were created using a propensity scoring method derived from logistic regression models. Propensity scores help adjust or correct statistical relations when randomization is absent, but the goal is to make causal inference about effects of some treatment or intervention (Indurkhya, Mitra, & Schrag, 2006). The statistical corrections help balance groups for any systematic differences or confounding background characteristics (i.e., exposure differences) that might introduce bias and create a threat to internal validity (D'Agostino, 1998). A group of confounding covariates is modeled using multivariable regression techniques with the end result being a "function" or single propensity score that discriminates membership in an intervention or treatment group (Rosenbaum & Rubin, 1983; Rubin, 1979).[4]

[4]Variables modeled to obtain adjusted propensity scores included prior round measures that predict exposure (divided into quintiles) including school attendance, current grade level, academic performance (i.e., grades), participation in extracurricular activities, future plans, family functioning, antisocial behavior, association with antisocial peers, marijuana use by close friends, sensation seeking, self-reported tobacco or alcohol use of a long-standing nature, and amount of television viewing and radio listening. Inclusion of the television and radio measures in derivation of the CFP weight forced us to use nonresponse and selection weights in analyses of these exposure measures only.

Replicate weights provided poststratification adjustments for the complex survey design and to adjust for clustering of respondents. The method used to adjust variance estimators is based on the original work of Fay (1984, 1989) and subsequently refined by Rizzo and Judkins (2004; Judkins, 1990).[5] Growth models estimated with the campaign awareness variables used the full sample CFP weights. Growth models with measures assessing television and radio used the multiround longitudinal selection weights, and attrition analyses used the replicate variance weights. To our knowledge no existing commercial software program that estimates growth models handles replicate weights to produce consistent unbiased parameter estimates with a linearization or Taylor series approximation method (L. Muthén, personal communication, 2008).

Measures

Campaign Awareness

Campaign brand awareness included four questions probing awareness of newsprint antidrug ads (''In recent months, about how often have you seen such anti-drug ads in newspapers or magazines?''), with response categories ranging from ''Not at all'' (1) through ''More than one time a day'' (6); ads shown in movie theaters (''In recent months, about how often have you see such anti-drug ads in the movie theaters or on rental videos?'') with response categories ranging from ''Haven't gone to movies or rented videos in recent months'' (0) through ''More than 1 time a day'' (6); public viewing (''In recent months, about how often have you seen anti-drug billboards or other public anti-drug ads such as on buses, in malls, or at sports in events?'') with response categories ranging from ''Not at all'' (1) through ''More than 1 time a day'' (6); and awareness through television or radio (''In recent months, about how often have you seen such anti-drug ads on TV, or heard them on the radio?''), with response categories ranging from ''Not at all'' (1) through ''More than 1 time a day'' (6). A total awareness composite score then was created ranging from 9 to 180, with imputation for respondents who were asked separate television and radio questions in waves 1 to 4 (Round 1). This measure then was transformed to a four-level ordinal measure grouping awareness into ''less than once per month'' (1), ''1 to 3 times per month'' (2), ''4 to 11 times per month'' (3), and ''12 or more times per month'' (4).

As part of the in-home survey, youth were shown digitized versions of various ads shown during the previous 60-day period in their area. The ads were shown to the general public in ''flights'' or grouped themes tied to the campaign goals. Each year included four flights with 10–12 weeks of exposure time. Two to three ads grouped thematically were shown in any one flight. Survey questions probed recall of these video clips based on ever seen (''Have you ever seen or heard this ad?''), with responses coded as ''yes'' or ''no,'' and number of times seen (''In recent months, how many times have you seen or heard this ad?''), with responses coded ''Not at all'' (1), ''Once'' (2), ''2 to 4 times,'' ''5 to 10 times,'' and ''More than 10 times.'' As a validity check, youth also were queried whether they had seen a ''ringer'' ad that had not aired during the designated time period (but were not calculated as part of

[5]The adjustment or correction to variance estimators included replicate-specific poststratification factors. These were $h_k = 2.57$ for $k = 1, 2, \ldots, 60$ replicate weights and $h_k = 0.06$ for $k = 61, 62, \ldots, 100$ replicate weights. Calculation of the variance and standard deviation estimates is based on the formula: $SE(\hat{y}) = \sqrt{\sum_{k=1}^{100} h_k (\hat{y}_k - \hat{y})^2}$.

their overall recall score). Scores then were statistically adjusted through imputation to correct for the disproportionate number of ads shown to minorities (African American and bilingual Hispanic youth were shown more ads as part of the campaigns efforts to target these youth). The resultant imputed scores then were summed across all eligible ads in order to obtain a measure of total recall for campaign-based ads. A corresponding weighting algorithm was applied to a matrix of the two recall questions (ever seen the ad and how many times) with increasing valence applied to greater recall. This score then was scaled to a four-point measure ranging from "Less than one time per month" (0), "One to less than 4 times per month" (1), "4 to less than 12 times per month" (2), and "12 or more times per month" (3).

Additional measures of campaign awareness included an assessment of antitobacco ad recall ("How often did you see or hear anti-tobacco TV/radio ads in the last 6 months?") with responses ranging from "Not at all" (1) to "More than one time a day" (6), a dichotomous (yes/no) measure assessing recall of stories in the media depicting youth and drugs. The measure was derived from five media types including television/radio, movies, talk shows, movies/videos, and magazines; a measure averaging the number of ads recalled in the past 60-day period (averaging across the total number of ads recalled when shown to the youth as part of their specific recall-aided awareness measure); a measure averaging the number of hours watching television on weekends and during the weekday; and a measure averaging hours spent listening to the radio combining weekend and weekday hours.

Alcohol and Drug Use

Assessment of alcohol and drug use relied on an Anonymous Computer Assisted Self-report Interview (ACASI). Two alcohol use items[6] assessed being drunk or high ("How many times were you drunk or very high from alcohol in the last 12 months?") with response categories ranging from "I don't use alcohol" (0) through "40 or more occasions" (7); and heavy alcohol use based on a measure of binge drinking ("How many days have you had five or more drinks in the last 30 days?") with response categories ranging from "I don't drink" (0) through "10 or more times" (6). Cigarette use was assessed with a single item ("How many cigarettes smoked a day during the last 30 days?") with response categories ranging from "None" (0) through "More than 35 per day, about 2 packs or more" (7). A single frequency item assessed marijuana involvement ("How many times have you used marijuana in the last 12 months?") with response categories ranging from "I have never used marijuana" (0) through "40 or more occasions" (6).

Analyses and Model Testing Strategy

We first tested a basic "univariate" growth model for each of the three drug use measures and then followed this procedure with tests of growth for the individual

[6]The ACASI instrument was set up to include skip patterns for youth responding "No" to the drug experience questions (e.g., "Have you ever drank alcohol?"). Use of skip patterns resulted in many youth not responding to items tapping frequency or intensity of use. In order to include more youth in the analyses and examine variation attributed to nonuse, we added categories reflecting responses of "I never used . . ." to each question in the skip pattern. Adding these youth back into the analyses allowed us to estimate growth relations that consider the addition of youth transitioning from nonuse to use over time. (Otherwise, they would have been excluded from subsequent rounds and not analyzed.)

measures of campaign awareness. We specified piecewise linear growth models for the drug and awareness models (Chou, Yang, Pentz, & Hser, 2004; Li, Duncan, & Hops, 2001). The piecewise model incorporated different slopes for when these youth were younger versus older (using S_1 to capture growth from 12 to 14 and S_2 from 14 to 18). Rather than assuming the growth trends would be homogeneous for the different age groups, we hypothesized that the trajectory for the high school years would be qualitatively different in shape and form compared with when these youth were in junior high school. In the case of drug use there are substantial age-related peer and social influence factors that could cause this differentiation, and in the case of awareness, different patterns of utilization (e.g., with increasing age youth may cut back on television for school work or employment) might influence the course of growth.

After estimation of the respective univariate growth models, we then posited a combined bivariate growth model. The bivariate model addresses the core theoretical issues of the media campaign: whether increasing campaign awareness over time is associated with concomitant decreases in drug use. In addition, the bivariate model also produces lagged effect parameters, which estimate the association between early campaign awareness and growth in drug use, and conversely between early drug use and growth in awareness (as a direct test of drug consequences and their disruptive influence). Following these models, then we estimated a model positing the different measures of recall and awareness as ''time-varying'' covariates estimating their independent effects on drug use, controlling for the underlying growth.

Results

Sample Description

The sample was 52% male, and this remained consistent across all four rounds. The sampling strategies employed to ensure the dataset was nationally representative of the major racial groups resulted in two-thirds (67.3%) being White (only Round 1 data presented), 13.8% Black, 15.1% Hispanic, and 3.8% other (non-Hispanic). Among Hispanic youth, 8% reported their origin as Mexican, 1% Puerto Rican, 0.4% Cuban, and 2% other Hispanic origin. Numbers of youth in each age cohort across the four Rounds are shown in Table 1. Based on sampling protocols, very few new youth were recruited in each successive round, and youth older than 18 were not tracked longitudinally.

Table 1. Sample sizes by round and age cohort

	Round of data collection			
Age	1	2	3	4
12	920	23		
13	850	565	15	
14	475	903	560	19
15	262	592	906	568
16	8	383	604	872
17		49	388	619
18			42	437
Total	2515	2515	2515	2515

Patterns of Drug Use Across the Four Rounds

Table 2 shows the prevalence rates for each age cohort from 12 to 18 years of age. As expected, with increasing age a greater number of youth reported some drug experience. At the age of 12 only about 1% or 2% of youth reported any use, but by the time they were 18, 44% reported alcohol use, 27% binge drinking in the past 30 days, 25% using cigarettes, and 30% having tried marijuana. Consistent with the campaign goals of targeting youth in the most vulnerable years, there was an apparent major developmental inflection appearing between 14 and 15 years of age, with precipitous rises in the numbers of youth saying they had tried all three drugs. Notably, the rates are still somewhat lower than comparable rates for the national youth surveys for the same historical period (e.g., Johnston et al., 2007).

Panel Attrition Analyses

Attrition analyses were structured to determine whether certain factors operate systematically to cause dropout from the study. Proportional analyses using the χ^2 test were used for cross tabulation of binary measures and logistic regression modeling to examine the optimal predictors of retention (coded "1" stay and "0" dropout). We used the WesVar software program to estimate logistic regression models of panel attrition. This statistical modeling program enables us to adjust (through poststratification) the sample variance estimators for the undersampling of primary sampling units and correct any bias in parameter estimates related directly to the complex sampling design (using replicate variance estimators to adjust standard errors for design effects).

Proportional tests indicated that panel youth were significantly more likely to be female, smoke more cigarettes, drink alcohol, and smoke marijuana (all χ^2 proportional tests significant at the $p \leq .0001$) compared with dropout youth. Given the large number of variables possibly related to retention status, logistic models were run separately for five individual domains (demographics, campaign awareness, drug use, school-related factors, and psychosocial risk).[7] Following tests of the individual domains, we culled only significant predictors and tested these in a combined model predicting retention. The final model indicated that retained youth were less at risk for marijuana use (unstandardized $b = -3.51$, $p \leq .0001$, OR $= .03$), engaged in more antisocial behavior (evidencing suppression: [$b = .23$, $p \leq .0001$, OR $= 1.26$]), spent fewer hours listening to the radio on a daily basis ($b = -.09$, $p \leq .01$, OR $= .91$), and were more likely to have attended school in the past year ($b = 1.05$, $p \leq .01$, OR $= 2.87$) compared with their dropout counterparts. Using the Cox-Snell likelihood pseudo-R^2 statistic, the model accounted for 12% of the variance in retention status, $F(14,87) = 12.127$, $p \leq .0001$.

[7]Predictors in the attrition analyses included demographic and background measures (gender, dummy coded measures of race to contrast White, Black, and Hispanic versus all other ethnic groups, respectively, and a measure of religious service attendance); drug use measures (alcohol, cigarettes, and marijuana); campaign awareness (brand awareness and specific recall-aided exposure, television and radio exposure to antidrug messages, and television viewing and radio listening behavior), school-related factors (grades, absenteeism, educational plans, a summed index of extracurricular school activities, and whether the respondent attended school in the past 12 months); and measures of psychosocial risk (antisocial behavior and a regression-derived measure of risk for marijuana use).

Table 2. Prevalence of drug use by age group

Age (years)	Alcohol (past 12 months)	Binge (past 30 days)	Cigarettes (past 30 days)	Marijuana (past year)
12	.02	.01	.02	.01
13	.05	.02	.03	.04
14	.11	.05	.06	.09
15	.21	.11	.11	.16
16	.32	.16	.17	.22
17	.39	.22	.21	.28
18	.44	.27	.25	.30

Results of the Growth Modeling

Figure 1 graphically shows the two-factor unconditioned growth model for the cohort analysis. This model parameterization serves as a basic template on which all models were tested for linear growth. Basis points or loadings for the intercept growth factor centered the structured means at age 12 as the initial status or reference point. Equally spaced basis points were used to specify linear growth for each of the two respective slope growth factors, one capturing growth from age 12 to 14 and the second trend designating growth from ages 14 to 18.

Table 3 shows the fit indices and model parameters for all of the univariate models tested. A careful inspection of this table shows that most of the estimated growth models fit the sample data. With the exception of the model for marijuana, the Comparative Fit Indices (CFI: Bentler, 1990) for each model is relatively large and exceeds the .90 benchmark (at least 90% of the model-implied means and covariances fit the observed sample means and covariances: Hu & Bentler, 1998). The root mean square error of approximation (RMSEA: Browne & Cudeck, 1993; MacCallum, Browne, & Sugawara, 1996) and standardized root mean square residual (SRMR) are used to indicate lack of fit. In general, smaller values (<.05) indicate congruence between the off-diagonal elements of the sample and population

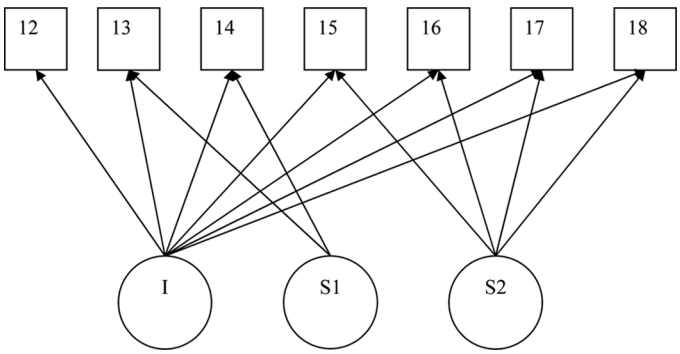

Figure 1. Univariate piecewise growth model. I = Intercept; S1 = Slope 1; S2 = Slope 2; 12 = measure at age 12. Equal interval basis loadings for slope factor indicates linear growth form (0, 1, 2, 3). Not shown for purposes of clarity are curved lines with two-headed arrows representing associations between initial status (intercept) and rate of growth (slope).

Table 3. Fit statistics for univariate growth models

					Parameter estimates								
	Model fit indices				Means			Variances			Correlations		
Variable name	χ^2	CFI	RMSEA	SRMR	I	S_1	S_2	I	S_1	S_2	I,S_1	I,S_2	S_1,S_2
Alcohol Use	69.719 (13)***	.919	.042	.091	.003	.071***	.274***	.015	.070***	.163***	−.006	−.008	.011
Binge Drinking	24.567 (13)*	.959	.019	.064	.002	.042***	.161***	−.003	.026**	.066***	.002	.002	.003
Cigarettes Use	71.545 (13)***	.930	.043	.109	.011	.095***	.288***	.131	.174**	.312***	−.020	−.022	.061*
Marijuana Use[1]	58.338 (12)***	.883	.039	.150	.004	.081***	.262***	.003	.088**	.187***	.011	−.025	.040
Media Stories	8.621 (13)	1.000	.000	.040	.920***	.023***	−.002	.028**	.007*	.000	−.012*	−.002	.001
Brand	22.931 (13)*	.980	.018	.030	2.089***	.124***	−.071***	.441***	.146*	.044*	−.170**	−.033	−.011
Specific Recall[2]	20.192 (15)	.985	.012	.053	1.145***	.198***	.084***	.234***	.000	.014*	NA	−.023*	NA
Anti-Tobacco Ads[3]	38.162 (16)**	.958	.024	.068	3.108***	.113**	−.133***	.742***	.000	.083***	NA	−.120***	NA
Television Watching	37.897 (13)***	.984	.028	.052	3.872***	−.020	−.198***	1.436***	.133	.105***	.002	−.146	−.023
Radio Listening	46.078 (13)***	.967	.032	.051	2.074***	.371***	.047*	1.629***	.454***	.156***	−.242	−.261	−.002

[1]The mean was freely estimated for Marijuana Use at age 18 for to improve the model fit.
[2]The mean was freely estimated for Specific Recall at age 18, and the variance for slope 1 was fixed at zero for proper model convergence.
[3]The variance for slope 1 was fixed at zero for Anti-Tobacco ads.
*$p < .05$; **$p < .01$; ***$p < .001$.
I = intercept; S_1 = slope 1; S_2 = slope 2; NA = not applicable due to fixed variance.

covariance matrices. There appears to be some tension in the way growth was specified for the cigarette and marijuana models, but the remaining models show relatively small RMSEA and SRMR fit statistics indicating there is adequate fit between the sample and implied population model.

Slope terms were all positive, indicating steady increases in drug use when these youth were younger (S_1) and as they matured to the latter part of adolescence (S_2). Interestingly, a comparison of slope terms for the younger years to the later years shows the growth trends are somewhat steeper (larger in magnitude) for the S_2 parameter, indicating faster growth during the high school years. Turning to the campaign awareness parameters, we see two findings worth noting. First, growth in campaign awareness is positive for the earlier years (12 to 14), except for television viewing behavior, which had a slope not significantly different from zero. As these youth became older (14 to 18), their awareness declined for every media venue except specific recall (videos shown on laptops) and radio listening behavior. Also, the magnitude of the slope terms were considerably larger at the younger age for recall of stories about drugs and youth, brand awareness, specific recall, and radio listening but larger in magnitude for television (declining) as these youth transitioned to high school.

The far-right-hand section of Table 3 shows the relationships between the intercepts and slope terms and also the association between the two slope terms. The two columns containing the associations between the intercept and slope terms indicate how fast awareness grew among these youth. A negative relationship indicates that youth with lower levels of campaign awareness at age 12 grew fastest over time (or declined slower if the awareness slope was negative). This was the case for recall of stories in the media about drugs and youth ($r = -.012$, $p \leq 05$) and general brand awareness ($r = -.170$, $p \leq .01$) during the early portion of adolescence. In the latter portion of adolescence this negative relationship included specific recall of the video clips ($r = -.023$, $p \leq .05$) and antitobacco ads ($r = -.120$, $p < .001$).

Results of the Bivariate Growth Models

Figure 2 graphically presents a generic template for testing the bivariate cohort growth models. Again, two slope trends are posited to capture the different rates of growth for youth when they were younger versus when they were older, and this is repeated for both drug use (D) and awareness (A) measures. Table 4 contains the results of the bivariate growth models. In general, these were all well-fitting models with CFI $> .90$, small residual variances expressed by the RMSEA and SRMR and optimal ratio of χ^2/df. Of interest in this table are the parameters indicating (1) effects of early campaign awareness on growth in drug use ($AI \rightarrow DS_1$ and $AI \rightarrow DS_2$); (2) effects of early drug use on growth in campaign awareness ($DI \rightarrow AS_1$ and $DI \rightarrow AS_2$); and (3) the slope-to-slope correlations (DS_1,AS_1 and DS_2,AS_2), the latter parameter capturing a major campaign effect. Turning first to effects of early campaign awareness on growth in drug use, we see there are only two significant lagged effects for youth when they were younger ($AI \rightarrow DS1$), and they are both positive (binge alcohol use with both radio listening: $\beta = .163$, $p \leq .05$ and recalling stories about youth and drug use: $\beta = .109$, $p \leq .01$). The positive relationship indicates youth with appreciably higher levels of awareness when they were younger grew faster in drug use during the years between 12 and 14. The column to the immediate right in Table 4, which captures the same effect when these youth are older

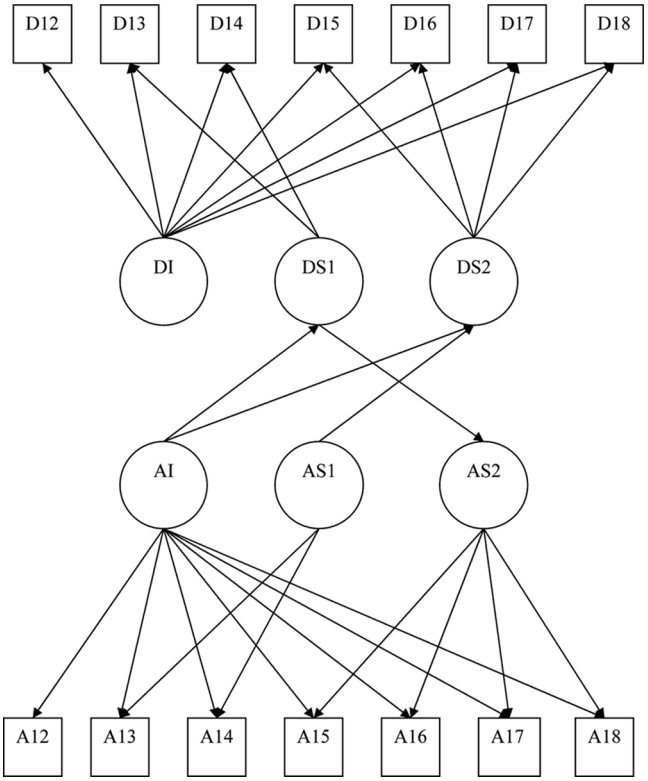

Figure 2. Bivariate piecewise growth model. The variance of intercept was fixed at zero for all of the drug use variables, and thus there are no regression lines depicted on the drug use intercept. Residuals are not shown in this figure. D = drug use variable; A = Awareness (recall) variable. Also not shown for purposes of clarity are curved lines denoting correlations between DI and DS1 and DI and DS2.

(AI→DS2), also shows there are seven significant and positive lagged effects. Thus, even at the different age periods, those youth with initially higher levels of campaign awareness grew faster in their drug use (there were three effects for alcohol, one for cigarettes, and three for marijuana).

A second concern is whether drug use interferes with campaign awareness. Unfortunately, we were unable to robustly estimate the full range of possible consequence effects because of variance estimation problems with the drug use intercept. Estimation of correlations between drug intercept and other model parameters was prevented because of offending estimates (often called "Heywood" cases: Dillon, Kumar, & Mulani, 1987) that prevent model convergence. This occurs when a variance is trivially small or negative, usually resulting from extremely skewed measures, which we encountered with the self-reported drug use for younger age youth (age 12).

The one piece of information that we were able to obtain and that addresses consequences is under the column labeled $DS_1 \rightarrow AS_2$. This parameter captures the effect of growth in drug use when the participants were younger on their growth in campaign awareness when they were older. Here, if we treat awareness not as a

Table 4. Fit statistics for bivariate growth models

Drug Use	Awareness	χ^2	CFI	RMSEA	SRMR	DI→AS$_1$ Std Est	DI→AS$_2$ Std Est	DS$_1$→AS$_2$ Std Est	AI→DS$_1$ Std Est	AI→DS$_2$ Std Est	AS$_1$→DS$_2$ Std Est	DI,AI Std Est	DS$_1$,AS$_1$ Std Est	DS$_2$,AS$_2$ Std Est
Alcohol[1]	Brand	221.874 (63)***	.907	.033	.072	NA	NA	−.254	.031	.199	−.016	NA	.035	.109
Alcohol[1]	Recall[2]	217.364 (66)***	.905	.030	.079	NA	NA	−.163	.020	.038	NA	NA	NA	.099
Alcohol[1]	Tobacco Ads[3]	255.403 (67)***	.898	.034	.081	NA	NA	−.258	.098	.084	NA	NA	NA	.051
Alcohol[1]	Television	227.209 (63)***	.940	.032	.078	NA	NA	.271*	−.040	.036	−.126	NA	−.074	−.259*
Alcohol[1]	Radio	224.078 (63)***	.927	.032	.073	NA	NA	−.318*	.101	.99	.107	NA	.204**	.116
Alcohol[1]	Media Stories	177.193 (63)***	.908	.027	.066	NA	NA	−.516	.055	.431***	.292*	NA	.051**	.010
Binge[1]	Brand	78.568 (63)	.983	.010	.052	NA	NA	−.068	−.085	.291*	−.042	NA	−.001	.085
Binge[1]	Recall[2]	101.874 (66)**	.956	.015	.059	NA	NA	−.094	−.021	.009	NA	NA	NA	.181
Binge[1]	Tobacco Ads	94.533 (63)**	.967	.014	.062	NA	NA	−.205	.012	.348	−.542	NA	.005	.135
Binge[1]	Television	245.673 (63)***	.933	.035	.103	NA	NA	.250	−.086	−.877	.922	NA	.161	−.143
Binge[1]	Radio	127.503 (63)***	.958	.020	.060	NA	NA	−.578***	.163*	−.003	.121	NA	.199*	.574***
Binge[1]	Media Stories	61.183 (63)	1.000	.000	.047	NA	NA	−.660	.109**	.343*	.269	NA	.029	.146
Cig Use[1]	Brand	243.003 (63)***	.904	.035	.069	NA	NA	−.039	.112	.088	−.227	NA	−.075	.070
Cig Use[1]	Recall[2]	202.807 (66)***	.922	.029	.089	NA	NA	.036	−.042	.034	NA	NA	NA	.304
Cig Use[1]	Tobacco Ads	266.399 (63)***	.906	.037	.100	NA	NA	−.077	.101	.541	−.853	NA	−.127	.030
Cig Use[1]	Television	129.793 (63)***	.965	.021	.068	NA	NA	.256	−.029	.041	.038	NA	−.143	−.305*
Cig Use[1]	Radio	240.672 (63)***	.930	.034	.102	NA	NA	−.233*	.171	.183	.124	NA	.288**	.277**
Cig Use[1]	Media Stories	207.437 (63)***	.913	.031	.089	NA	NA	.039	.015	.310*	.328	NA	.019	−.711
Marijuana[1]	Brand	210.828 (63)***	.900	.031	.092	NA	NA	−.077	.080	.261*	−.022	NA	−.007	−.010
Marijuana[1]	Recall[1]	164.215 (66)***	.930	.024	.086	NA	NA	.229	−.022	.144*	NA	NA	NA	−.207
Marijuana[1]	Tobacco Ads	222.535 (63)***	.896	.033	.099	NA	NA	.038	.067	.459	−.699	NA	−.222	−.017
Marijuana[1]	Television	181.353 (63)***	.940	.027	.096	NA	NA	.134	.019	.801	−.826	NA	−.197	−.179
Marijuana[1]	Radio	168.786 (63)***	.936	.026	.092	NA	NA	−.161	.054	.122	.089	NA	.221**	.194
Marijuana[1,4]	Media Stories	179.550 (62)***	.890	.028	.090	NA	NA	−.445	.042	.293**	.171	NA	.036	−.152

[1]The variance was fixed at zero for the intercept (age 12) of the drug use variables.
[2]For Binge-Recall the mean at age 18 for Recall was freely estimated and the variance of slope 1 was fixed at zero.
[3]For Alcohol Use-Anti-Tobacco Ads, the variance of slope 1 for Anti-Tobacco Ads was fixed at zero.
[4]For Marijuana-Media Stories, the mean was freely estimated at age 18 for Marijuana.
*$p < .05$; **$p < .01$; ***$p < .001$.
DI = drug use intercept; DS = drug use slope; AI = awareness intercept; AS = awareness slope; NA = not applicable due to fixed variance.

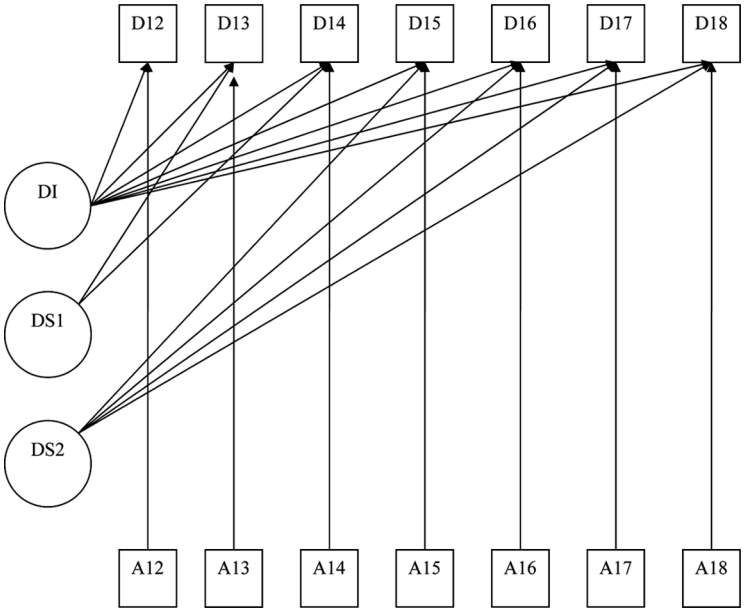

Figure 3. Piecewise drug use growth model with time varying covariates of campaign awareness. D12 to D18 represent measured drug use variables and A12 to A18 is the corresponding campaign awareness exposure measure.

measure of actual viewing of the commercials and PSAs but rather as a measure of recall (how much youth recall seeing the campaign ads on television or listening to them on the radio), then this particular parameter expresses whether growth in drug use interferes with recall. Four of these relations were significant (alcohol and television: $\beta = .271$, $p \leq .05$, alcohol use and radio listening: $\beta = -.318$, $p \leq .05$, heavy alcohol use and radio: $\beta = -.578$, $p \leq .001$, and cigarette use and radio: $\beta = -.233$, $p \leq .05$). Three of these (negative effects) indicate that increasing amounts of drug use were associated with poor recall, whereas the fourth positive relation indicates that there is a stimulation of television viewing from increases in binge drinking.

Another analytic focus concerns the slope-to-slope correlations (the two far-right columns in Table 4), which captures a major program effect. The question posed by the slope correlations addresses whether increasing amounts of campaign exposure (awareness) is in any way related to downturns in their drug use. The question is posed separately for when these youth were younger (DS_1,AS_1) and older (DS_2,AS_2). Of the 24 possible models tested for the younger period, five had significant slope relations and all were positive. This indicates that increasing awareness and recall of campaign messages was associated with increasing levels of drug use. A total of eight of the 24 models tested were negative (supporting positive campaign effects), but none of these inverse relations achieved significance. Turning to the period when these youth were older, there was evidence of positive campaign effects in the model for television watching and alcohol use ($r = -.259$, $p \leq .05$) and likewise in the model for television watching and cigarette use ($r = -.305$, $p \leq .05$). The remaining two slope correlations were both positive, supporting an iatrogenic or boomerang effect (radio and heavy alcohol use: $r = .574$, $p \leq .001$ and radio and

Table 5. Media Exposure as Time Varying Covariate

Drug Use[a]	Awareness	χ^2	CFI	RMSEA	SRMR	A12→D12 Std Est	A13→D13 Std Est	A14→D14 Std Est	A15→D15 Std Est	A16→D16 Std Est	A17→D17 Std Est	A18→D18 Std Est
Alcohol	Brand	135.499 (32)***	.915	.037	.063	−.017	−.038	.029	−.023	−.011	−.043	−.018
Alcohol	Recall	122.130 (32)***	.927	.034	.063	.066	.027	.064**	.005	.016	−.001	.028
Alcohol	Tobacco Ads	145.739 (32)***	.914	.038	.063	.059	−.042	.012	−.039**	−.022	−.061*	−.038
Alcohol	Television	53.815 (32)**	.956	.017	.041	.072*	−.051	−.054	−.062*	−.043	−.046	−.059
Alcohol	Radio	131.453 (32)***	.918	.035	.055	−.027	.016	.105**	.026	.006	−.016	−.002
Alcohol	Media Stories	138.476 (13)***	.922	.037	.059	.029**	−.027	.000	−.016	−.006	−.020	−.006
Binge	Brand	135.499 (32)***	.912	.037	.063	−.017	−.038	.029	−.023	−.011	−.043	−.018
Binge	Recall	48.256 (32)*	.967	.014	.042	.092*	−.023	−.018	−.019	.001	.006	.020
Binge	Tobacco Ads	32.990 (32)	.998	.004	.042	.048	.000	.021	−.006	.008	−.001	−.005
Binge	Television	53.815 (32)**	.956	.017	.041	.072*	−.051	−.054	−.062*	−.043	−.046	−.059
Binge	Radio	53.583 (32)**	.958	.016	.043	.135*	.099*	.132**	.040	.000	−.019	−.049
Binge	Media Stories	40.510 (32)	.984	.010	.039	.021	−.031	−.026	−.018	−.001	.002	.008
Cig Use	Brand	163.016 (32)***	.906	.042	.085	.005	−.039	−.010	−.018	.004	.008	.023
Cig Use	Recall	117.286 (32)***	.938	.033	.075	.042	.014	.020	.026	.045**	.032	.039
Cig Use	Tobacco Ads	170.980 (32)***	.915	.042	.089	−.042	.010	.051	−.003	−.005	−.014	−.018
Cig Use	Television	142.637 (32)***	.925	.037	.087	−.040	−.062	−.027	−.041	−.016	−.029	−.026
Cig Use	Radio	152.280 (32)***	.922	.039	.087	.106*	.057	.081*	.055**	.072**	.043	.045
Cig Use	Media Stories	178.025 (32)***	.922	.043	.086	.013	−.035*	−.019	−.016	−.001	.003	.007
Marijuana	Brand	129.624 (32)***	.905	.036	.085	.008	−.043	.011	−.019	−.004	−.008	−.029
Marijuana	Recall	98.539 (32)***	.937	.029	.077	.036	.008	.049	.006	.019	.016	−.008
Marijuana	Tobacco Ads	132.926 (32)***	.904	.036	.087	.001	−.005	−.016	−.009	−.016	−.027	−.081
Marijuana	Television	87.413 (32)***	.934	.026	.077	.034	−.039	.003	−.032	−.017	−.019	−.051
Marijuana	Radio	87.199 (32)***	.934	.026	.079	−.002	−.017	.075	.020	.005	−.001	−.073
Marijuana	Media Stories	140.505 (32)***	.900	.037	.087	.021*	−.031	−.003	−.007	.001	.004	−.004

[a]The variance was fixed at zero for the intercept (age 12) of the drug use variables.
A = Awareness; D = Drug Use; A12→D12 = Drug use for the cohort beginning at age 12 regressed on awareness (recall) at age 12.
*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.

cigarette use: $r = .277$, $p \leq .01$).[8] Interestingly, and with the exception of radio listening, all of the marijuana models were negative, albeit none were significant. This does indicate, however, that over time, as these youth reported increasingly more awareness and recalled increasingly more campaign messages, there was a concomitant decrease in their reported levels of marijuana use.

Manipulating Media Awareness

As we explained previously, there is another way to address the campaign effects that consider awareness as a manipulated or treatment measure. In other words, rather than identifying the measures of awareness as recall, they can be conceivably thought of as measures of "exposure" to the campaign. This would be consistent with a randomized field trial where exposure levels were manipulated (increased or decreased) comparatively between a treatment and control condition. Figure 3 graphically depicts that awareness is modeled as a time-varying covariate and its influence estimated on the measures of drug use at each respective age. As the figure shows, we are modeling a direct regression of the drug use measures (alcohol, cigarettes, and marijuana) on awareness for each age after controlling for the underlying growth in drug use over time. The results of this model are contained in Table 5. Again, the far left side of the table indicates each of the models fit well and that there is good congruence between the sample and implied population model (means and covariances). In fact, some of the problems previously encountered with the marijuana models are no longer apparent. The various standardized estimates indicate whether awareness influences drug use growth beginning at that age for that cohort (each age period is treated independently). As we can see, there are seven positive estimates for the 12-year-old cohort, one positive and one negative for the 13-year-old cohort (cigarette use and recall of stories about youth and drugs: $\beta = -.035$, $p \leq .05$), four positive effects for 14 year olds, one positive effect and three negative effects for 15 year olds (alcohol and antitobacco ads: $\beta = -.039$, $p \leq .01$; alcohol and television viewing: $\beta = -.062$, $p \leq .05$; and binge alcohol use and television watching: $\beta = -.062$, $p \leq .05$), two positive effects for 16 year olds, one negative effect for 17 year olds (alcohol and recalling antitobacco ads: $\beta = -.061$, $p \leq .05$), and none that were significant for the 18-year-old group. Overall, the combination of these effects demonstrates that awareness is related in some cases to less drug use, supporting the intended positive campaign effect.

Discussion

This article examined effects of the NYADMC using a cohort-based growth framework to detect whether increased viewing and recall of campaign messages is associated with declines in drug use. A growth framework that can account for the process linking campaign awareness and drug use had not been previously tested bringing into question whether reported "boomerang" or iatrogenic effects might

[8]The column labeled $AS_1 \rightarrow DS_2$ that is contained in Table 3 reflects a "regression" of the slope for drug use (when the youth were older) on growth in campaign awareness when they were younger. This is another way to ask whether growth in awareness of campaign themes was protective and exerted an influence for younger youth as they matured. Only one relation is significant ($r = .292$, $p \leq .05$) for alcohol and recalling seeing ads about youth and drugs. Nine of the 24 models tested did produce an inverse relation; however, these did not achieve statistical significance.

be specious to the analytic framework. The improvements with modeling growth potentially could uncover positive campaign effects that might endorse mass media communication campaigns like the NYADMC as suitable for the population in question. In order to systematize the quite extensive analyses presented here, we divide the discussion into four sections owing to how they shape our understanding of campaign efficacy: (1) the nature of growth for drug use and campaign awareness, (2) the different age-graded effects, (3) discussion of iatrogenic effects, and (4) whether there was support for positive campaign effects. We also discuss possible theoretical and conceptual refinements to the campaign strategy that arise from this study.

Trajectories of Growth in Drug Use

The piecewise or discontinuous models specifying growth in drug use suggest that compared with their early years, youth accelerated their drug use more quickly in the later portion of their teenage years (14 to 18). There is behavioral information (not reported here) that supports this acceleration. For instance, even though rounds are not the true "marker" of progress but rather age is, we know that the proportion of youth reporting having tried drugs grew precipitously at each round. This was clearly indicated by the addition of new users; the numbers of youth who transitioned from nonuse to use at each age, and increased frequency and intensity of use among those already experimenting with drugs (i.e., greater numbers of cigarettes smoked and more heavy drinking).

It is worth noting that prevalence rates for this sample deviated somewhat from national rates, with the NSPY sample reporting somewhat lower rates of use at the younger ages and higher rates of use as the sample matured. There are several factors that may precipitate these noted discrepancies. First, the differences may be an artifact of different data collection methodologies, particularly survey versus in-home computerized interviews (Fendrich & Johnson, 2001). Moreover, the actual wording of drug use questions was not identical with national surveillance surveys, which may rule out any direct comparisons between rates of use. Self-report bias and the possibility of under-reporting in the initial stages of the NSPY also might account for the gross differences in reported prevalence rates. That is, youth in the NSPY sample are initially uncomfortable with the use of computers in their home, thinking their parents will still see their answers. This is not the case with anonymous paper-and-pencil surveys in schools that avoid connecting personal identification with a youth's answer. As the NSPY youth mature and gain some familiarity with computerized data collection methods, their reporting becomes more veridical, resulting in larger estimates of reported drug use, exceeding those reported in national surveys.

To check this, we obtained estimates of use from other longitudinal panel samples and compared these with the NSPY and MTF numbers. One source of data was obtained from a cohort-sequential study of alcohol and drug etiolog,[9] while another was obtained from a school-based drug abuse prevention program[10] (untreated

[9]Oregon Youth Substance Use Project (OYSUP), Funded by the National Institute on Drug Abuse (DA10767) with data collection running between 1999 and 2005, Principal Investigator Judy Andrews, Ph.D., Oregon Research Institute.

[10]Drug Abuse and Violence Prevention with Minority Youth, Funded by the National Institute on Drug Abuse (DA08905) with data collection running between 1998 and 2002, Principal Investigator, Gilbert J. Botvin, Ph.D., Weill Medical College of Cornell University, Institute for Prevention Research.

control students only). We matched the ages of these youth as closely to the NSPY participants as permitted, and the period of data collection overlapped between the respective studies (to rule out historical influences). In the cohort-sequential longitudinal study, which used in-home interviews combined with self-report questionnaires, combining across five separate 12-year-old cohorts prevalence rates for alcohol across 6 years were 6%, 14%, 21%, 31%, 32%, and 41% through 17 years of age, respectively. Prevalence rates for past 30-day cigarette smoking were 2%, 4%, 9%, 13%, 19%, and 24%. Rates of past 30-day marijuana use were 1%, 4%, 9%, 14%, 18%, and 21%.

In the school-based drug abuse prevention program, which used confidential, self-report, paper-and-pencil questionnaires, prevalence rates for the control youth from sixth to tenth grades were 15%, 20%, 28%, 38.5%, and 45%, respectively, for alcohol; 3.5%, 11%, 14%, 18%, and 20% for cigarettes; and 1%, 5%, 7%, 14%, and 18.5% for marijuana. This brief comparative analysis shows that when participants mature in a longitudinal study, there emerges a pattern of consolidated drug use with greater numbers of youth engaging in drugs over time. We might expect there to be a consolidation of drug use behaviors as the NSPY sample matures, particularly since entry into the college years traditionally has been marked by a rapid increase in drug use including binge drinking, an expansion of drugs used, and new personal freedoms (Bachman, Wadsworth, O'Malley, Johnston, & Schulenberg, 1997; Chen & Kandel, 1995; Rutledge & Sher, 2001).

Trajectories of Growth for Campaign Awareness

The picture of growth for campaign awareness measures differed markedly from what was observed for drug use. In the early years, growth in campaign awareness was mostly linear and positive for the different types of messaging themes with the exception of television watching, which had a relatively flat trajectory. With increasing age, however, the pattern reversed and growth mostly was characterized by downward trajectories, with the exception of listening to the radio and specific recall of campaign videos (themes), which increased. In some cases, the trajectories seemed to be stronger in the early years (brand awareness) and then less steep in later years. We also found that brand recognition and specific recall of video clips accelerated more steeply in the younger years. This bodes well for the campaign, showing that the PSAs and commercials are more tractable at younger ages, which are the critical and vulnerable years. The ability to isolate age-graded effects for the slope terms is important because it helps elucidate the respective success of different campaign strategies to reach the target audience (ages 12 to 15 seems critical for drug use initiation). The age-graded effect also extended to television viewing behavior, which declined more steeply as the sample matured. The declining utilization of television may reflect maturation and increasing demands from school and extracurricular activities including sports, work, and family responsibility. Television and radio represent the two most important, and highly utilized venues for mass media interventions. In the present study, however, we get mixed findings as to the utility of these outlets, given that there was declining utilization of television throughout, increasing radio listening in the early portion of adolescence, and then reduced growth in this medium with increasing age. In terms of growth for the remaining venues, recall of stories about youth and drugs and antitobacco ads were relatively unchanged across the time span.

Age-Graded Effects

The various age-graded effects mainly are concerned with whether campaign awareness was informative about drug use when youth were younger as opposed to older and whether similar patterns held up for drug use consequences on campaign awareness. These effects are elucidated in the relations between intercept and slope terms in the univariate models and the regression parameters corresponding to the lagged effects in the combined bivariate models. Turning first to the univariate case, we see that there was relatively little information gained from knowing a youth's initial level with regard to how fast they grow in drug use or campaign awareness, and this held for whether they were younger or older. The 20 models tested revealed that only four were significant, and, in all cases, youth who reporting initially lower levels grew the fastest (two each at the different age periods). All four of these models involved awareness, suggesting that barraging these youth with messages in the early portion of adolescence will stimulate them to recall them later on and perhaps inundate them with the appropriate antidrug notions.

The bivariate lagged effects paint a completely different picture and support age-graded relations between awareness and drug use. This raises the specter that the campaign effects were different in the early portion of adolescence compared with the latter portion, where we suspect some behaviors are more entrenched. For instance, awareness in the early portion of adolescence was associated with only two effects for binge alcohol use, but the sheer number of effects rose to six when these youth reached later adolescence. Admittedly, all these relations support iatrogenic campaign effects. In the other age-graded effects, increasing alcohol use in the early portion of adolescence was associated with decreasing radio listening behavior in later adolescence, binge alcohol use was associated with decreasing radio listening, and increasing cigarette use was associated with less radio listening, all three supporting negative consequences from early drug use.

There are several angles from which to better appreciate the role of negative consequences or reverse causation in the campaign effects. Drugs can influence recall and awareness in myriad ways, including their soporific pharmacological effect, loss of memory from prolonged use, reduced cognitive abilities, and neuropsychological deficits. Regardless of the precise underlying mechanism, if youth are immersed in a drug culture or just "turning off" to the message content, the campaign diminishes in importance and fails to reach these troubled youth. Alternative channels may be required to reach hardened drug-using youth, addressing, in particular, their limited media exposure arising from disaffection in school and from other conventional institutions where media messages are delivered or discussed (i.e., school-based drug programs).

The Nature of Iatrogenic Effects

It should be clear by now that the numbers of iatrogenic effects certainly outweigh positive campaign effects. There are several factors that may help us to better understand what produces iatrogenic effects. First, it is imperative that we learn more about youths' perceptions of the campaign messages, particularly because we do not know what precipitates their "awareness," whether certain features of the campaign messages are more salient, or whether their awareness of a campaign's themes is calibrated depending on drug use status. In fact, this type of "conditioning" effect

that links prior existing risk with program outcomes has been a staple part of drug prevention research. Evaluations of school-based drug prevention programs, for instance, show different program effects for experienced drug using versus inexperienced or nonusing youth (Donaldson, Graham, & Hansen, 1994; Ellickson, Bell, & Harrison, 1993; MacKinnon, Weber, & Pentz, 1989). Moreover, the campaign may have to consider that with such a broad-brush effect served ubiquitously to all youth across America, we just do not have the rigorous controls we need to determine if the messages reach nonusing youth in the same manner as drug-using youth and convey the same content that is intended. This also points toward the need for controlled laboratory studies that can experimentally manipulate message content and determine whether the campaign's efficacy reaches across different groups of youth in a similar manner (Terry-McElrath et al., 2005).

Does Growth in Campaign Awareness Influence Drug Use?

A different picture emerges when we put the different pieces of the growth trajectories together. In the early stages when these youth are between 12 and 14 years of age, there is not much support for positive campaign effects; in fact, all of the significant relations between slopes reinforce iatrogenic effects as previously has been reported (Orwin et al., 2006). When we look at these same effects corresponding to the latter portion of adolescence (14 to 18), however, there are two pieces of evidence that suggest campaign messages are getting across and supporting the desired positive outcomes. This occurs with alcohol-using youth and those smoking cigarettes, behaviors that diminished in conjunction with growth in television watching. Even though they reported increasing their television watching behavior, we cannot be sure they were exposed to campaign messages, but we do know that there is something protective about this behavior. Interestingly, we did not get any supportive campaign effects for marijuana despite the content emphasis of the Marijuana Initiative. That is not to say the data do not support a positive campaign effect with marijuana, because all of the slope-to-slope relations were negative, just not significant.

When we piece all of these findings together, there are at least two possibilities that may interfere with the effectiveness of the initiative. First, youth just may not believe the campaign message themes. In particular, they may doubt the veracity of the proposed negative health outcomes or damaging social and personal consequences that are portrayed in the campaign PSAs. Second, there may be an element of "meta-messaging," in the form of heightened sensitivity to the drug problem responsible for the increase in drug use following exposure to the campaign. This phenomenon arises because the message content tells youth that drug use is widespread among their peers or at least normatively prescribed. Moreover, when youth are taught that drugs can cause irreparable harm, but they also are told that drugs are widely used, they form a "disbelief" in the information content of the messages. Alternatively, psychological reactance theory (Brehm, 1966; Ringold, 2002) has been used to account for the unexpected effects. In this view, youth react to the imposition of dogmatic rules and behavioral conduct expectations that are expressed through campaign messages at a time when rebellion against established institutions is widespread and formative in their thinking. When robbed of their freedom to make independent behavioral choices (i.e., perceived threat), youth rebel by using drugs as a statement of autonomy. Both explanations are theoretically plausible but must be tested in future analyses.

We also can employ micro-analysis of the campaign effects pitting brand recognition or awareness against the other forms of recall. Brand recognition was measured as a collage of questions asking participants whether they recollected hearing antidrug ads on the radio, viewing them on television, or seeing ads for the campaign in papers or magazines, in movies (trailers), or on publically displayed billboards. These represent general ways in which a youth can catch a glimpse of the campaign, but also represent the strongest element of the campaign where the most effort was spent to showcase campaign messages. Interestingly, there was an association between lower initial levels of brand awareness and faster growth in heavy alcohol use, albeit this relationship was not significant. It does suggest, however, that a modicum of messaging is getting across and that increasing awareness suppresses acceleration of alcohol use. Only further moderator analyses that entail comparisons of nonusers versus more experienced users can tease apart whether the campaign achieved its goals of keeping youth from initiating drug use at all.

Is the Campaign Theory Wrong?

Consistent with the underlying theoretical premise outlined in the TRA, the goal of the campaign is to get youth to cognitively evaluate their choices and realize that most of their peers and even adults do not positively value drugs, that drugs interfere with achieving positive life goals, and they do not create positive outcomes as anticipated. This was the heart and soul of the campaign messaging content and should deter youths' "behavioral willingness" to use drugs. So why, then, did the campaign not get the type of effects originally intended (particularly for marijuana) and what additional work needs to be done to uncover these effects should they exist? Two possible scenarios come to mind. One suggests that third-variable alternatives are needed to account for the effects of the campaign, variables that instigate drug use and also account for some variation in campaign awareness. Many of the third-variable alternatives that we might have modeled were removed in the service of equilibrating groups to create the specter of randomization. Propensity scoring offers a means to statistically control for measures that may confound awareness-drug relations but at the same time removes important sources of variation that are involved in processes we wish to detect. In the current study, the propensity scores contained sources of influence that might relate to acquisition of marijuana behavior (i.e., marijuana use by close friends) and also account for some variation in campaign awareness (truant or delinquent youth hang out and smoke together while listening to the radio).

A second concern is that the Marijuana Initiative took place at the tail end of the campaign (2002) and did not have sufficient time to work its magic using the current follow-up timeline. In other words, using a growth framework would not be the proper technique to detect a change in campaign effects over time. Rather, a time series framework would be needed to detect the place in time when the maximal effect was achieved given the change in campaign content emphasis. This goes back to our original point that "gateway spillover" effects are driving the few significant positive campaign effects we obtained. Is this good for the campaign? This is difficult to answer in a simple and straightforward manner. On the one hand the campaign took shape as a broad-brush social marketing health persuasion campaign to deter youth from using drugs. Use at this age refers mostly to initiation or experimental use. The argument posed by gateway theorists is that most use begins with alcohol

and progresses in an invariant sequence to include cigarettes, pills, marijuana, and then more progressively harder illicit drugs (e.g., cocaine). Why then did the campaign target primarily marijuana in the media content and insist that the initial focus be on youth ages 11 to 14 and then with the initiative shift this emphasis to 12 to 15? This does not make sense given that youth in this age group, if they are tempted by pressures to use drugs, drink alcohol or smoke cigarettes first before using marijuana.

If a social marketing campaign wants to be successful, it should choose to remediate behaviors that are less intransigent to change. Why focus almost exclusively on marijuana, which surely is being used by the most deviant and hard-to-reach youth? Brand awareness may not persuade these youth to give up their marijuana use given they are intransigent to messages from the establishment. More than likely these youth have rejected school and cast aside its conventional outlook, and they have lost touch with many other important social institutions. In other words, why not focus on earlier forms of the behavior like alcohol or cigarettes where there is sufficient empirical support for positive campaign effects obtained from other mass media interventions (Farrelly et al., 2002; Flynn et al., 1994; Murray et al., 1994)? In these few instances, there are notable changes in attitudes, beliefs and even behavior following exposure to mass media interventions to reduce tobacco use among youth.

This point was further reinforced when we examined whether campaign awareness acted like an independent measure and exerted a "static" influence on drug use, using a growth model specifying time-varying covariates. In this framework, the effect of awareness was identified at each age as though manipulated in an experimental design. Although this approach is not consistent with the actual design of the study, it provides a means to examine a different angle on whether the awareness-drug use relation is affected by youths' age. These models also reinforced that there is a mixture of iatrogenic effects coupled with evidence of some positive campaign effects (15 iatrogenic and 5 favoring the campaign). The only pattern that emerged is that most of the supportive campaign effects involved alcohol (one cigarette model) and none marijuana, again supporting the contention that the campaign may want to consider reshaping its focus on a different set of outcomes.

General Limitations and Future Directions

Even with the expressed advantages to modeling developmental features of the campaign, there are several limitations to the present study worth noting. First, there are in fact numerous ways to conceptualize campaign effects that go much deeper than the simplified growth models we tested. Any discussion of these conceptual models has to consider the numerous problems associated with a naturalistic study lacking complete randomization. In short, there was no "intervention" to speak of, but rather the campaign took shape as a naturalistic observational study conducted at a particular point in time with no clear demarcation from various historical influences that could affect patterns of reported drug use. This leads to one of several uncertainties that we cannot attribute causation to the statistical relations despite using longitudinal data. At some point, a decision will have to be made to recruit the national media into a nationwide campaign that requires random assignment of defined regions or tractable census units with observations based on individual

youth behavior. The hierarchically structured data then can be subject to rigorous scrutiny in an effort to see if the campaign affords any protection above and beyond the normal fare of prevention resources offered in schools and communities (see Flay, 2000; Flay & Burton, 1990).

It also is true that we cannot rule out additional "uncertainties" that have to do with the method of data collection (self-report ACASI methods) for both drug use and exposure measures. We really do not have a "true" measure of exposure other than asking individual participants if they recall campaign themes at a general level or more specifically whether they recall (with visual prompting) seeing a specific advertisement played for them using a laptop. Even with inclusion of ringer ads that help tease out fabricated recall, we cannot be certain that youth recall campaign themes in a consistent fashion. The absence of any confirming methods could contribute to the irregular pattern of positive and negative findings obtained in this study. We do not know whether "drug" was the key operative term in the Marijuana Initiative or whether the emphasis on marijuana would be responsible for alteration of behavior. Likewise, we cannot be sure that the effects intended on marijuana and that were observed with alcohol and cigarettes resulted from spillover or subjective interpretations by youth regarding the potential harm from drugs. These concerns, combined with the absence of both randomization and a rigorous means to track exposure at the individual level, may lead to false conclusions regarding the stability and surety of findings. In this regard, more rigorous measures of exposure with greater reliability and validity could improve the quality of a media campaign evaluation in general.

There also are alternative theoretical conceptualizations to consider regarding the operative mechanisms of the campaign. For instance, the Elaboration Likelihood Model (ELM: Petty & Cacioppo, 1986) suggests that persuasion involves cognitive elaboration (i.e., attitude change) that can enhance persuasive value (see also Slater & Rouner, 2002). In this respect, we did not test the various belief and cognitive structures that are principal targets of the campaign messages. In fact, we tested very simplified models that purport that more awareness and recall of campaign themes would be associated with declines in drug use. None of the models we tested attribute to the specific theoretical framework of TRA, where cognitions are the driving force in behavior change.

Others have suggested that youth are embedded in a social network (Hornik, 2006) and that effects should be considered with respect to changes in prevailing norms involving perceived drug use by friends (Gunthar, Bolt, Borzekowski, Liebhart, & Dillard, 2006). There are concerns regarding message receptivity and characteristics of the recipient matching features of the message (Santa & Cochran, 2008). In other words, we do not know which features of the campaign messages are persuasive and whether perceivers are vigilant to the different features of campaign messages or whether they attend to information about normative behavior, consequences of drug use, or general indications that drugs are unhealthy. These concerns fall under the concept of "engagement" and are a large part of the ELM. Likewise, we have very little information on whether youth rely on central as opposed to peripheral route processing in decoding campaign messages.

Some laboratory-based work has been done in this regard (Czyzewska & Ginsburg, 2007; Harrington et al., 2003), but dissection of the campaigns "active ingredients" and analysis of message design strategies and message processing is

relatively new. The Activation Model of Information Exposure (Donohew, Palmgreen, & Duncan, 1980; Donohew, Palmgreen, & Lorch, 1994) suggests that attentional features of the individual message recipient must be factored into the message content in order to boost the effectiveness of health persuasion strategies. Again, this would incorporate the absence of any effects on marijuana and the observed positive campaign effects for alcohol and cigarettes only. To put it one way, the engagement value of the marijuana ads was low and did not tap into the self-interests of these youth. There also is evidence that certain individual personality characteristics like sensation seeking may moderate campaign effectiveness (Palmgreen et al., 2001). Certain message features are more palatable to high sensation seeking youth, owing to the cognitive involvement required to decode messages. The message sensation value has to be considered in light of the different campaign modalities (television, radio, print, billboards, movie trailers, to name a few), which may differentially attract viewers as we observed in their respective trajectories of use over time.

Other factors to consider include the heightened public sensitivity to the drug problem, which has the effect of exposing youth to a wide range of messages that extend beyond the reach of the campaign. That is, other school-based and communitywide efforts may make it hard for youth to distinguish what is ''campaign'' related compared with what is part of the constant background noise of prevention and antidrug activities. In this respect, the campaign might benefit from including questions not only about involvement in outside prevention activities but also probing counterarguments and cognitive elaboration that are part of mainstream marketing studies. With this approach, we can find out whether the messages are persuasive, whether youth are receptive to message content, and from an information processing point of view, whether youth use the message content to alter their beliefs and behavior. This would provide a more formal test of the campaign and go beyond merely asking youth whether they recall the campaign based on brand recognition or visual recall of video segments.

Finally, we are uncertain whether broad-brush analyses like those suggested here represent the best analytic framework to test the campaign's success. More microanalytic approaches that dissect the underlying behavioral heterogeneity might be required. One possibility is to use latent class analysis to dissect heterogeneity in awareness and better understand the different patterns of media usage. Coupled with this is the underlying variability in drug use and then linking the two to determine whether there are latent ''classes'' of youth who diverge on their receptivity to campaign themes. Growth mixture models then can be used to estimate whether different latent classes (based on recall) have different developmental trajectories for drug use. In addition, despite the wealth of information we obtain from modeling growth, there is the observation that we do not know if campaign messages shown early in the early portion of the campaign stretched their impact over time. Were PSAs broadcast during Round 1 more ''potent'' than messages shown in later Rounds? In this respect, we cannot know exactly where we get the ''biggest bang for the buck'' and assume with a growth model that there was a steady dose–response relationship across time. Interrupted time series and other statistical methods that can dissect the point of greatest impact would help address this concern. All told, however, we need to be able to make finer and finer discrimination in evaluating the efficacy of the campaign in order to make sure that we are not throwing out the baby with the bath water.

References

Ajzen, I., & Fishbein, M. (1973). Attitudinal and normative variables as predictors of specific behaviors. *Journal of Personality and Social Psychology*, *27*, 41–57.

Ajzen, I., & Fishbein, M. (1977). Attitude-behavior relations: A theoretical analysis and review of empirical research. *Psychological Bulletin*, *84*, 888–918.

Bachman, J. G., Wadsworth, K. N., O'Malley, P. M., Johnston, L. D., & Schulenberg, J. E. (1997). *Smoking, drinking, and drug use in young adulthood: The impacts of new freedoms and new responsibilities*. Hillsdale, NJ: Lawrence Erlbaum Associates.

Belicha, T., & McGrath, J. (1990). Mass media approaches to reducing cardiovascular disease risk. *Public Health Reports*, *105*, 245–252.

Bentler, P. M. (1990). Comparative fit indexes in structural models. *Psychological Bulletin*, *107*, 238–246.

Botvin, G. J., & Griffin, K. W. (2005). Prevention science, drug abuse prevention, and Life Skills Training: Comments on the state of the science. *Journal of Experimental Criminology*, *1*, 63–78.

Brehm, J. W. (1966). *A theory of psychological reactance*. New York: Academic Press.

Brook, J. S., Whiteman, M., Finch, S. J., Morojele, N. K., & Cohen, P. (2000). Individual latent growth curves in the development of marijuana use from childhood to young adulthood. *Journal of Behavioral Medicine*, *23*, 451–464.

Brown, E. C., Catalano, R. F., Fleming, C. B., Haggerty, K. P., & Abbott, R. D. (2005). Adolescent substance use outcomes in the Raising Healthy Children Project: A two-part latent growth curve analysis. *Journal of Consulting and Clinical Psychology*, *73*, 699–710.

Brown, J. D., & Einsiedel, E. F. (1990). Public health campaigns: Mass media strategies. In E. B. Ray & L. Donohew (Eds.), *Communication and health: Systems and applications* (pp. 153–170). Hillsdale, NJ: Lawrence Erlbaum Associations, Inc.

Browne, M. W., & Cudeck, R. (1993). Alternative ways of assessing model fit. In K. A. Bollen & J. S. Long (Eds.), *Testing structural equation models* (pp. 136–162). Newbury Park, CA: Sage Publications.

Chen, K., & Kandel, D. B. (1995). The natural history of drug use from adolescence to the mid-thirties in general population sample. *American Journal of Public Health*, *85*, 41–47.

Chew, F., Palmer, S., & Kim, S. (1998). Testing the influence of the Health Belief Model and a television program on nutrition behavior. *Health Communication*, *10*, 227–245.

Chou, C.-P., Yang, D., Pentz, M. A., & Hser, Y.-I. (2004). Piecewise growth curve modeling approach for longitudinal prevention study. *Computational Statistics & Data Analysis*, *46*, 213–225.

Curran, P. J., Stice, E., & Chassin, L. (1997). The relation between adolescent alcohol use and peer alcohol use: A longitudinal random coefficients model. *Journal of Consulting and Clinical Psychology*, *65*, 130–140.

Czyzewska, M., & Ginsburg, H. J. (2007). Explicit and implicit effects of anti-marijuana and anti-tobacco TV advertisements. *Addictive Behaviors*, *32*, 114–127.

D'Agostino, R. B. (1998). Propensity score methods for bias reduction in the comparison of treatment to a non-randomized control group. *Statistics in Medicine*, *17*, 2265–2281.

Dempster, A. P., Laird, N. M., & Rubin, D. B. (1977). Maximum likelihood from incomplete data via the EM algorithm. *Journal of the Royal Statistical Society, Series B*, 1–38.

Dillon, W. R., Kumar, A., & Mulani, N. (1987). Offending estimates in covariance structure analysis: Comments on the causes of and solutions to Heywood cases. *Psychological Bulletin*, *101*, 126–135.

Donaldson, S. I., Graham, J. W., & Hansen, W. B. (1994). Testing the generalizabilty of intervening mechanism theories: Understanding the effects of adolescent drug use prevention interventions. *Journal of Behavioral Medicine*, *17*, 195–216.

Donohew, L., Palmgreen, P., & Duncan, J. (1980). An activation model of information exposure. *Communication Monographs*, *47*, 295–303.

Donohew, L., Palmgreen, P., & Lorch, E. P. (1994). Attention, need for sensation, and health communication campaigns. *American Behavioral Scientist*, *38*, 310–322.

Duncan, T. E., & Duncan, S. C. (1995). Modeling the process of development via latent growth curve methodology. *Structural Equation Modeling*, *2*, 187–213.

Duncan, S. C., & Duncan, T. E. (1996). A multivariate latent growth curve analysis of adolescent substance use. *Structural Equation Modeling*, *3*, 323–347.

Duncan, T. E., Duncan, S. C., & Strycker, L. A. (2006). *An introduction to latent variable growth curve modeling: Concepts, issues, and applications* (2nd ed.). Mahwah, NJ: Lawrence Erlbaum Associates.

Ellickson, P. L., Bell, R. M., & Harrison, E. R. (1993). Changing adolescent propensities to use drugs: Results from Project ALERT. *Health Education Quarterly*, *20*, 227–242.

Farr, A. C., Witte, K., Jarato, K., & Menard, T. (2005). The effectiveness of media use in health education: Evaluation of an HIV/AIDS television campaign in Ethiopia. *Journal of Health Communication*, *10*, 225–235.

Farrelly, M. C., Healton, C. G., Davis, K. C., Messeri, P., Hersey, J. C., & Haviland, M. L. (2002). Getting to the truth: Evaluating national tobacco countermarketing campaigns. *American Journal of Public Health*, *92*, 901–907.

Fay, R. E. (1984). Some properties of estimates of variance based on replication methods. In *Proceedings of the Section on Survey Research Methods* (pp. 495–500). Alexandria, VA: American Statistical Association.

Fay, R. E. (1989). Theory and application of replicate weighting for variance calculations. *Proceedings of the Section on Survey Research Methods* (pp. 212–218). Alexandria, VA: American Statistical Association.

Fendrich, M., & Johnson, T. P. (2001). Examining prevalence differences in three national surveys of youth: Impact of consent procedures, mode, and editing rules. *Journal of Drug Issues*, *31*, 665–694.

Flay, B. R. (2000). Approaches to substance use prevention utilizing school curriculum plus social environment change. *Addictive Behavior*, *25*, 861–885.

Flay, B. R., & Burton, D. (1990). Effective mass communication campaigns for public health. In C. Atkin & L. Wallack (Eds.), *Mass communication for public health* (pp. 129–191). Newbury Park, CA: Sage Publications.

Flynn, B. S., Worden, J. K., Secker-Walker, T. H., Badger, G. J., Geller, B. M., & Costanza, M. C. (1992). Prevention of cigarette smoking through mass media intervention and school programs. *American Journal of Public Health*, *82*, 827–834.

Flynn, B. S., Worden, J. K., Secker-Walker, R. H., Pirie, P. L., Badger, G. J., Carpenter, J. H., & Geller, B. M. (1994). Mass media and school interventions for cigarette smoking prevention: Effects 2 years after completion. *American Journal of Public Health*, *84*, 1148–1150.

Graham, J. G., Hofer, S. M., & MacKinnon, D. P. (1996). Maximizing the usefulness of data obtained with planned missing value patterns: An application of maximum likelihood procedures. *Multivariate Behavioral Research*, *31*, 197–218.

Griffin, K. W., & Botvin, G. J. (2009). Preventing substance abuse among children and adolescence. In R. Ries et al. (Ed.), *Principles of addiction medicine* (4th ed., pp. 1375–1382). Baltimore: Lippincott Williams & Wilkins.

Gunthar, A. C., Bolt, D., Borzekowski, D. L., Liebhart, J. L., & Dillard, J. P. (2006). Presumed influence on peer norms: How mass media indirectly affect adolescent smoking. *Journal of Communication*, *56*, 52–68.

Harrington, N. G., Lane, D. R., Donohew, L., Zimmerman, R. S., Norling, G. R., An, J.-H., Cheah, W. H., McClure, L., Buckingham, T., Garofalo, E., & Bevins, C. C. (2003). Persuasive strategies for effective anti-drug messages. *Communication Monographs*, *70*, 16–38.

Hawkins, J. D., Catalano, R. F., & Miller, T. Y. (1992). Risk and protective factors for alcohol and other drug problems in adolescence and early adulthood: Implications for substance abuse prevention. *Psychological Bulletin*, *112*, 64–105.

Hornik, R. (2006). Personal influences and the effects of the National Youth Anti-Drug Media Campaign. *Annals, AAPSS*, *608*, 282–300.

Hornik, R., Maklan, D., Cadell, D., Barmada, C., Jacogsohn, L., Henderson, V., Romantan, A., Niederdeppe, J., Orwin, R., Sridharan, S., Chu, A., Morin, C., Taylor, K., & Steele, D. (2003). *Evaluation of the National Youth Anti-Drug Media Campaign: Sixth Semiannual Report of Findings*. Report prepared for the National Institute on Drug Abuse (Contract No. N01DA-8-5063). Washington, DC: Westat.

Hovland, C., Janis, L., & Kelley, H. (1953). *Communication and persuasion*. New Haven, CT: Yale University Press.

Hu, L., & Bentler, P. M. (1998). Fit indices in covariance structural equation modeling: Sensitivity to underparameterized model misspecification. *Psychological Methods*, *3*, 424–453.

Indurkhya, A., Mitra, N., & Schrag, D. (2006). Using propensity scores to estimate the cost-effectiveness of medical therapies. *Statistics in Medicine*, *25*, 1561–1576.

Johnston, L. D., O'Malley, P. M., Bachman, J. G., & Schulenberg, J. E. (2007). *Monitoring the Future national survey results on drug use, 1975–2006. Volume I: Secondary school students* (NIH Publication No. 07-6205). Bethesda, MD: National Institute on Drug Abuse.

Judkins, D. (1990). Fay's method for variance estimation. *Journal of Official Statistics*, *6*, 223–240.

Kandel, D. B. (2002). *Examining the gateway hypothesis: Stages and pathways of drug involvement*. New York: Cambridge University Press.

Kandel, D. B., & Faust, R. (1975). Sequence and stages in patterns of adolescent drug use. *Archives of General Psychiatry*, *32*, 923–932.

Kandel, D. B., Yamaguchi, K., & Chen, K. (1992). Stages of progression in drug involvement from adolescence to adulthood: Further evidence for the gateway theory. *Journal of Studies on Alcohol*, *53*, 447–457.

Kotler, P., & Roberto, E. L. (1989). *Social marketing: Strategies for changing public behavior*. New York: The Free Press.

Kotler, P., & Zaltman, G. (1971). Social marketing: An approach to planned change. *Journal of Marketing*, *35*, 3–12.

Lazarsfeld, P. F., & Merton, R. K. (1949). Mass communication, popular taste, and organized social action. In L. Bryson (Ed.), *The communication of ideas* (pp. 95–118). Oxford: Harper.

Li, F., Duncan, T. E., & Hops, H. (2001). Examining developmental trajectories in adolescent alcohol use using piecewise growth mixture modeling analysis. *Journal of Studies on Alcohol*, *62*, 199–210.

MacCallum, R. C., Browne, M. W., & Sugawara, H. M. (1996). Power analysis and determination of sample size for covariance structure modeling. *Psychological Methods*, *1*, 130–149.

MacKinnon, D. P., Weber, M. D., & Pentz, M. A. (1989). How do school-based drug prevention programs work and for whom? *Drugs and Society*, *3*, 125–143.

Mason, W. A., Kosterman, R., Hawkins, J. D., Haggerty, K. P., & Spoth, R. L. (2003). Reducing adolescents' growth in substance use and delinquency: Randomized trial effects of a parent-training prevention intervention. *Prevention Science*, *4*, 203–212.

McCombie, S., Hornik, R. C., & Arnarfi, J. K. (2002). Effects of a mass media campaign to prevent AIDS among young people in Ghana. In R. C. Hornik (Ed.), *Public health communication: Evidence for behavioral change* (pp. 147–161). Englewood Cliffs, NJ: Lawrence Erlbaum Associates, Inc.

McGuire, W. J. (1961). Resistance to persuasion conferred by active and passive prior refutation of the same and alternative counterarguments. *Journal of Abnormal and Social Psychology*, *63*, 326–332.

McGuire, W. J. (1966). Attitudes and opinions. *Annual Review of Psychology*, *17*, 475–514.

McGuire, W. J. (1968). The nature of attitudes and attitude change. In G. Lindzey & E. Aronson (Eds.), *Handbook of social psychology* (pp. 136–314). Reading MA: Addison-Wesley.

Mehta, P. D., & West, S. G. (2000). Putting the individual back into individual growth curves. *Psychological Methods*, *5*, 23–43.

Murray, D. M., Prokhorov, A. V., & Harty, K. C. (1994). Effects of a statewide antismoking campaign on mass media messages and smoking beliefs. *Preventive Medicine*, *23*, 54–60.

Muthén, L. K., & Muthén, B. O. (1998–2007). *Mplus User's Guide, Version 4.1*. Los Angeles, CA: Muthén & Muthén.

Muthén, B. (2000). Methodological issues in random coefficient growth modeling using a latent variable framework: Applications to the development of heavy drinking in ages 18–37. In J. S. Rose, L. Chassin, C. C. Presson, & S. J. Sherman (Eds.), *Multivariate applications in substance use research: New methods for new questions* (pp. 113–140). Mahwah, NJ: Lawrence Erlbaum.

Newcomb, M. D., & Bentler, P. M. (1986). Frequency and sequence of drug use: A longitudinal study from early adolescence to young adulthood. *Journal of Drug Education*, *16*, 101–120.

Office of National Drug Control Policy (ONDCP). (1998). *Testing the Anti-Drug Message in 12 American Cities National Youth Anti-Drug Media Campaign Phase I* (Report No. 1), Washington, DC: Author.

Orwin, R., Cadell, D., Chu, A., Kalton, G., Maklan, D., Morin, C., Piesse, A., Sridharan, S., Steele, D., Taylor, K., & Tracy, E. (2006). *Evaluation of the National Youth Anti-Drug Media Campaign: 2004 Report of Findings*. Report prepared for the National Institute on Drug Abuse (Contract no. N01DA-8-5063). Washington, DC: Westat. Retrieved January 2007 from www.drugabuse.gov-DESPR-Westat-NSPY2004Report-Vol1-report.pdf

Palmgreen, P., Donohew, L., Lorch, E. P., Hoyle, R., & Stephenson, M. T. (2001). Television campaign and adolescent marijuana use: Tests of sensation seeking targeting. *American Journal of Public Health*, *91*, 292–296.

Park, J., Kosterman, R., Hawkins, J. D., Haggerty, K. P., Duncan, T. E., Duncan, S. C., & Spoth, R. (2000). Effects of the ''preparing for drug free years'' curriculum on growth in alcohol use and risk for alcohol use in early adolescence. *Prevention Science*, *1*, 125–138.

Pechman, C., & Reibling, E. T. (2000). Planning an effective anti-smoking mass media campaign targeting adolescents. *Journal of Public Health Management Practice*, *6*, 80–94.

Petty, R. E., & Cacioppo, J. T. (1986). *Communication and persuasion: Central and peripheral routes to attitude change*. New York: Springer-Verlag.

Popham, W. J., Potter, L. D., Hetrick, M. A., Muthen, L. K., Duerr, J. M., & Johnson, M. D. (1994). Effectiveness of the California 1990–1991 tobacco education media campaign. *American Journal of Preventive Medicine*, *10*, 319–326.

Ringold, D. J. (2002). Boomerang effects: In response to public health interventions: Some unintended consequences in the alcoholic beverage market. *Journal of Consumer Policy*, *25*, 27–63.

Rizzo, L., & Judkins, D. (2004). Replicate variance estimation for the national survey of parents and youth. In *Proceedings of the Section on Survey Research Methods of the American Statistical Association* (pp. 4257–4263). Alexandria, VA: American Statistical Association.

Rogosa, D., & Willett, J. B. (1985). Understanding correlates of change by modeling individual differences in growth. *Psychometrika*, *50*, 203–228.

Rosenbaum, P. R., & Rubin, D. B. (1983). The central role of the propensity score in observational studies for causal effects. *Biometrika*, *70*, 41–55.

Rubin, D. B. (1979). Using multivariate matched sampling and regression adjustments to control bias in observational studies. *Journal of the American Statistical Association*, *74*, 318–324.

Rutledge, P. C., & Sher, K. J. (2001). Heavy drinking from the freshman year into early young adulthood: The roles of stress, tension-reduction drinking motives, gender, and personality. *Journal of Studies on Alcohol*, *62*, 457–466.

Santa, A. F., & Cochran, B. N. (2008). Does the impact of anti-drinking and driving public service announcements differ based on message type and viewer characteristics? *Journal of Drug Education*, *38*, 109–129.

Scheier, L. M. (2001). Etiologic studies of adolescent drug use: A compendium of data resources and their implications for prevention. *The Journal of Primary Prevention*, *22*, 125–168.

Scheier, L. M., Botvin, G. J., Griffin, K. W., & Diaz, T. (2000). Dynamic growth models of self-esteem and adolescent alcohol use. *Journal of Early Adolescence*, *20*, 178–209.

Siegel, M., & Bierner, L. (2000). The impact of an antismoking media campaign on progression to established smoking: Results of a longitudinal youth study. *American Journal of Public Health*, *90*, 380–386.

Simons-Morton, B., Chen, R., Abroms, L., & Haynie, D. L. (2004). Latent growth curve analyses of peer and parent influences on smoking progression among early adolescents. *Health Psychology*, *23*, 612–621.

Slater, M. D., & Rouner, D. (2002). Entertainment-Education and elaboration likelihood: Understanding the processing of narrative persuasion. *Communication Theory*, *12*, 173–191.

Stannard, S., & Young, J. (1998). Social marketing as a tool to stop child abuse. *Social Marketing Quarterly*, *4*, 64–68.

Substance Abuse Mental Health Services Administration. (2007). *Results from the 2006 National Survey on Drug Use and Health: National Findings* (NHSDUH Series H-32, DHHS Publication No. SMA 07-4293). Rockville, MD: Office of Applied Studies.

Taylor, B. J., Graham, J. W., Cumsille, P., & Hansen, W. B. (2000). Modeling prevention program effects on growth in substance use: Analysis of five years of data from the Adolescent Alcohol Prevention Trial. *Prevention Science*, *4*, 183–196.

Terry-McElrath, Y., Wakefield, M., Ruel, E., Balch, G. I., Emery, S., Szczypka, G., Clegg-Smith, K., & Flay, B. (2005). The effect of antismoking advertisement executional characteristics on youth comprehension, appraisal, recall, and engagement. *Journal of Health Communication*, *10*, 127–143.

Wiebe, G. D. (1951–1952). Merchandising commodities and citizenship on television. *Public Opinion Quarterly*, *15*, 679–691.

Willett, J. B., & Sayer, A. G. (1994). Using covariance structure analysis to detect correlates and predictors of change. *Psychological Bulletin*, *116*, 363–381.

Wills, T. A., & Cleary, S. D. (1999). Peer and adolescent substance use among 6th–9th graders: Latent growth analyses of influence versus selection mechanisms. *Health Psychology*, *18*, 453–465.

Zucker, D., Hopkins, R. S., Sly, D. F., Urich, J., Kershaw, J. M., & Solari, S. (2000). Florida's Truth Campaign: A countermarketing anti-tobacco media campaign. *Journal of Public Health Management*, *6*, 1–6.