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Gateway to Curiosity: Medical Marijuana Ads and Intention and Use During Middle School

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Over the past several years, medical marijuana has received increased attention in the media, and marijuana use has increased across the United States. Studies suggest that as marijuana has become more accessible and adults have become more tolerant regarding marijuana use, adolescents perceive marijuana as more beneficial and are more likely to use if they are living in an environment that is more tolerant of marijuana use. One factor that may influence adolescents' perceptions about marijuana and marijuana use is their exposure to advertising of this product. We surveyed sixth- to eighth-grade youth in 2010 and 2011 in 16 middle schools in Southern California (n = 8,214; 50% male; 52% Hispanic; mean age = 13 years) and assessed exposure to advertising for medical marijuana, marijuana intentions, and marijuana use. Cross-lagged regressions showed a reciprocal association of advertising exposure with marijuana use and intentions during middle school. Greater initial medical marijuana advertising exposure was significantly associated with a higher probability of marijuana use and stronger intentions to use 1 year later, and initial marijuana use and stronger intentions to use were associated with greater medical marijuana advertising exposure 1 year later. Prevention programs need to better explain medical marijuana to youth, providing information on the context for proper medical use of this drug and the potential harms from use during this developmental period. Furthermore, as this is a new frontier, it is important to consider regulating medical marijuana advertisements, as is currently done for alcohol and tobacco products.

Keywords: adolescents, medical marijuana, advertising, marijuana use

Teen marijuana use is rising across the United States (Johnston, O'Malley, Bachman, & Schulenberg, 2013), and the number of frequent marijuana users (e.g., four or more times in a month) among youth and adults in the United States swelled 40% from 2006 (14.2 million people) to 2010 (17.6 million people; Caulkins, Kilmer, Reuter, & Midgette, 2015). This general increase in marijuana use mirrors changes in how adolescents perceive the drug. For example, one recent study found that among people ages 17–19 years, the popular promarijuana Twitter handle @stillblazingtho was in the top 10% of all Twitter handles followed (Cavazos-Rehg et al., 2011). A recent focus group study with at-risk youth found that most of these youth perceived marijuana use as "normal," with 90% voicing positive attitudes toward marijuana use (Sanders, 2012). Similarly, youth with a first-time alcohol or marijuana offense viewed using marijuana as less risky than drinking, and they also associated marijuana use with fewer negative consequences compared to drinking (D'Amico et al., 2015).

In this study, we focus on advertising for *medical marijuana.* People who have a medical marijuana card typically have a doctor's recommendation to use marijuana and are afforded some protection from arrest and criminal sanctions. Some studies have begun to assess how legalization of medical marijuana has affected attitudes toward marijuana. In a large study in Montana across several counties, Friese and Grube (2013) assessed 17,482 adolescents aged 13–19 years and examined the association between adolescent marijuana use and voter approval of medical marijuana and number of medical marijuana cards issued. They found that youth were more likely to report greater lifetime and past 30-day use of marijuana when they lived in counties with a higher percentage of voters approving legalization of medical marijuana; the number of medical marijuana cards was not related to marijuana use (Friese & Grube, 2013). Furthermore, states that have legalized medical marijuana report higher rates of marijuana use; however, from these data, it is not clear whether this is due to the actual legalization of medical marijuana or to community norms supportive of the legalization of medical marijuana (Cerdá, Wall, Keyes, Galea, & Hasin, 2012). Pacula and colleagues (Pacula, Powell, Heaton, & Sevigny, 2013) discuss the complexity of the effects of medical marijuana laws on marijuana use given that many states have different nuances to their policies that may affect this association. For example, they found that marijuana dependence was higher in states that had more lenient access to medical marijuana, such as home cultivation and state acceptance of dispensaries (Pacula et al., 2013). Overall, these recent studies suggest that as

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marijuana has become more accessible and adult views on marijuana have become more tolerant, adolescents are beginning to perceive marijuana as more beneficial and are more likely to use if they are living in an environment that is more tolerant of marijuana use.

Exposure to medical marijuana advertising may be an important influence on adolescents' perceptions about marijuana and marijuana use. Many studies have shown, for example, that there is a strong association between alcohol advertising and subsequent drinking among youth (Grenard, Dent, & Stacy, 2013; McClure, Stoolmiller, Tanski, Engels, & Sargent, 2013). Anderson, de Bruijn, Angus, Gordon, and Hastings (2009) conducted a systematic review of exposure to media and commercial communications of alcohol and found 13 longitudinal studies that followed up a total of more than 38,000 youth under the age of 21 years. These studies consistently found that exposure to alcohol advertising was related to both initiation of drinking among nondrinkers and increased drinking among those who already reported drinking at baseline. Over the past several years, medical marijuana has received increased attention in the media, billboards advertise medical marijuana, medical marijuana dispensaries now outnumber Starbucks stores in Denver (Dickson, 2011), and in March 2014, the first TV ad for medical marijuana appeared on Fox, CNN, and ESPN in New Jersey (Steinmetz, 2014). In California, there are more than 1,000 dispensaries, delivery services, and cooperatives throughout the state (National Organization for the Reform of Marijuana Laws, California Chapter, 2012). Furthermore, discussion of medical marijuana on TV (e.g., *60 Minutes: Will Colorado's Green Rush Last?* aired in December 2013) and advertising for medical marijuana have increased. Despite the increased attention on this drug, no studies to date have examined how medical marijuana advertising may affect younger adolescents' intentions to use and actual marijuana use. Of note, one recent study found that adolescents aged 12–18 years with more positive appraisals of the *antimarijuana* TV ads used in the National Youth Antidrug Media Campaign were less likely report intention to use marijuana and to continue marijuana use at 1-year follow-up (Alvaro et al., 2013).

It is well known that marijuana use during the important developmental period of adolescence is associated with a host of problems, such as poor school performance and psychological outcomes, use of other illicit drugs (including heroin and cocaine), and a higher likelihood of abuse or dependence in adulthood (Brook, Lee, Brown, & Finch, 2012; D'Amico, Ellickson, Collins, Martino, & Klein, 2005; Juon, Fothergill, Green, Doherty, & Ensminger, 2011). In addition, marijuana use is associated with neurocognitive deficits, such as poorer psychomotor speed, sustained attention, and cognitive inhibition (Lisdahl & Price, 2012). Furthermore, given that the brain is still developing, even after adolescents stop using marijuana and are abstinent for >23 days, they still have memory, attention, and reaction time deficits compared to youth who have never used marijuana (Medina et al., 2007).

Given the potential problems that marijuana use during adolescence can cause in later life, we need to better understand the factors that may affect intentions to use and initiation during this developmental period. We know of no prior research in this area; therefore, the current longitudinal study takes an important first look at the cross-lagged associations of advertising for medical marijuana on younger adolescents' intentions to use marijuana in the next 6 months and their actual marijuana use. We examined cross-lagged associations longitudinally because the *reinforcing spirals* model of media exposure and risk behavior has shown that exposure and behavior can mutually reinforce each other and potentially increase risk-taking behavior over time (Slater, 2007; Tucker, Miles, & D'Amico, 2013). For example, this dynamic process suggests that exposure to media may increase interest in that particular behavior and/or trying out that behavior (e.g., alcohol use, cigarette use, having sex), which can then lead to greater interest in pursuing that media content and increased chances of engaging in that behavior (Environmental Systems Research Institute, 2008; Slater, 2007; Task Force on Community Preventive Services, 2009).

Method

The sample comprised sixth- to eighth-grade students initially recruited in 2008 in 16 middle schools across three school districts in Southern California to evaluate the CHOICE substance use prevention program for middle school students (D'Amico et al., 2012). Schools were selected and matched to their nearest neighbor school based on the squared Euclidean distance measure, estimated using publicly available information on ethnic diversity, approximate size, and standardized test scores (D'Amico et al., 2012).

Across all schools, 92% of parents returned a consent form at the baseline, and approximately 71% of parents gave permission for their child to participate in the original study. Ninety-four percent of consented students completed the baseline survey, which is higher or comparable to other school-based survey completion rates with this population (Johnson & Hoffmann, 2000; Johnston, O'Malley, Bachman, & Schulenberg, 2009; Kandel, Kiros, Schaffran, & Hu, 2004). Surveys were administered on a prescheduled day during physical education class and took approximately 45 min to complete. Trained staff described the survey to students, reviewed confidentiality, and answered questions. Spanish-speaking staff members were available to answer student questions; survey booklets were available in Spanish and Korean. More information is available in previous publications (D'Amico et al., 2012; Shih, Miles, Tucker, Zhou, & D'Amico, 2010). The current study analyzes data from Wave 4 (June 2010) and Wave 5 (June 2011) of the study (2–3 years after the intervention took place); we retained approximately 84% of the baseline sample. Dropout was not associated with substance use outcomes.

We began to collect data on exposure to medical marijuana advertising at Wave 4 because a proposition to legalize marijuana was being discussed in the California Senate in January 2010 and was added to the California ballot in November 2010 (California Proposition 19, also known as the Regulate, Control & Tax Cannabis Act). The mean age of the sample at this time was 13 years. Youth were ethnically and racially diverse (e.g., 52% Hispanic; 17% Asian), and rates of substance use across waves were comparable to national samples (see Table 1). Specifically, in Monitoring the Future, 16.4% of eighth graders reported lifetime marijuana use in 2011 (Johnston, O'Malley, Bachman, & Schulenberg, 2012), compared with 15.8% in our eighth-grade sample.

Table 1
Demographics of the Sample (N = 8,214)

	Value
Male, %	50.2
Age, *M* (*SD*)	13.0 (0.95)
Race/ethnicity, %	
Asian	16.8
African American	3.2
Hispanic	52.2
Non-Hispanic White	15.8
Other/multiethnic	12.0
Past-month marijuana use, %	
Wave 4: 2010	3.3
Wave 5: 2011	4.8
Marijuana use intentions, *M* (*SD*)	
Wave 4: 2010	1.41 (0.95)
Wave 5: 2011	1.48 (0.98)
Exposed to advertising	
Wave 4: 2010	0.22
Wave 5: 2011	0.30

Note. Marijuana use intentions: 1 = *definitely no* to 4 = *definitely yes*; exposure to advertising: 1 = *not at all* to 7 = *every day*.

Surveys

Responses were protected by a Certificate of Confidentiality from the National Institutes of Health; procedures were approved by the individual schools and the institution's internal review board. Covariates included age, gender, race/ethnicity, academic performance, and intervention status. Of note, there were no intervention effects on marijuana use, and initial intervention effects on alcohol use were no longer significant after Wave 3 of the study (when we began collecting data on exposure to medical marijuana advertising); nonetheless, we controlled for CHOICE participation in the present analyses. *Exposure to medical marijuana advertising:* "In the past three months, how often have you seen advertisements for *medical* marijuana on billboards, in magazines, or somewhere else?" (response options ranged from 1 = *not at all* to 7 = *every day*). Advertising exposure was highly skewed and dichotomized as no exposure versus any exposure. Youth who were exposed reported seeing ads on average about once a month. *Intention to smoke marijuana:* "Do you think you will use any marijuana in the next six months?" (response options ranged from 1 = *definitely no* to 4 = *definitely yes*). *Marijuana use:* "During the past month, how many times did you use marijuana (pot, weed, grass, hash)?" (response options ranged from 1 = *0 days* to 7 = *20–30 days*). We dichotomized marijuana use into "any use" versus "no use" given that past-month use rates were low, as expected for this age group, and models would not converge using the continuous measure.

Results

The analytic sample comprised 8,214 individuals who responded at Wave 4 or 5. Maximum likelihood (ML) estimation was employed using Mplus 6.11 (Muthén & Muthén, 2011) with standard errors corrected for clustering at the school level. ML was used rather than the default WLSMV for several reasons. First, the assumptions that must be made when estimating models with missing data are more restrictive with WLSMV than with ML (Asparouhov & Muthén, 2010). Second, with ML estimation, we estimate the odds ratios, rather than the polychoric correlations; hence, there is a more direct link between the estimates in the model and the predicted probability of a behavior. One disadvantage of ML is that model fit indices are not available; however, this is not an issue as our models were saturated. We used cross-lagged regression (Finkel, 1995) to examine the association between (a) marijuana intentions and ad exposure and (b) marijuana use and ad exposure. The outcome variable and exposure at Wave 5 were both regressed on the outcome and exposure at Wave 4. Both measures, at both time points, were regressed on the covariates: age, gender, race/ethnicity, academic performance, and intervention status. The model is shown in path diagram format in Figure 1. Conventionally in a cross-lagged model, one correlates measures within time. This is not possible with categorical data (because the variances are not part of the model). Instead, we used the approach of adding a factor with loadings to both variables at each time point, which is an equivalent model to that with correlations and does not require the use of correlated error variances.

Twenty-two percent of adolescents at Wave 4 and 30% at Wave 5 reported seeing at least one advertisement for medical marijuana on billboards, in magazines, or somewhere else in the past 3 months. With regard to demographic and academic covariates, higher academic performance was associated with greater exposure to advertising ($p < .01$), and being male ($p = .014$) and of Asian descent (relative to white; $p < .01$) were associated with being exposed to fewer advertisements. For marijuana use at Wave 4, higher academic performance was associated with a greater likelihood of use ($p < .01$), and being of Asian descent or other race was associated with a lower likelihood of use ($p < .01$ and $p = .03$, respectively). For intentions to use, higher academic performance was associated with higher intentions ($p < .01$), and being of Asian descent ($p < .01$) was associated with lower intentions.

For the cross-lagged regression models, at both waves, as expected, these younger adolescents reported fairly low levels of past-month marijuana use (Wave 4: 3.3%; Wave 5: 4.8%) and low intentions to use in the next 6 months (Wave 4: $M = 1.41$, $SD = 0.95$; Wave 5: $M = 1.48$, $SD = 0.98$). Exposure to medical marijuana ads at Wave 4 predicted stronger intentions to use ($b = 0.73$, $SE = 0.06$, OR = 2.07, $p < .001$) and actual use ($b = 0.79$, $SE = 0.25$, OR = 2.20, $p = .002$) at Wave 5. Thus, youth who reported seeing any ads for medical marijuana were twice as likely as youth who reported never seeing an ad to use marijuana and to report higher intentions to use marijuana 1 year later. Marijuana use at Wave 4 ($b = 1.07$, $SE = 0.10$, OR = 2.92, $p < .001$) and intentions to use ($b = 0.09$, $SE = 0.03$, OR = 1.09, $p = .008$) also predicted exposure to medical marijuana ads at Wave 5. For example, youth who reported marijuana use were almost three times as likely to report seeing ads 1 year later.

Discussion

This study is the first step in a line of research to examine whether any exposure to medical marijuana advertising was associated with younger adolescents' marijuana intentions and actual use. Similar to the literature on alcohol advertising (Anderson et al., 2009), seeing advertisements for medical marijuana was related to middle school adolescents' intentions to use marijuana and

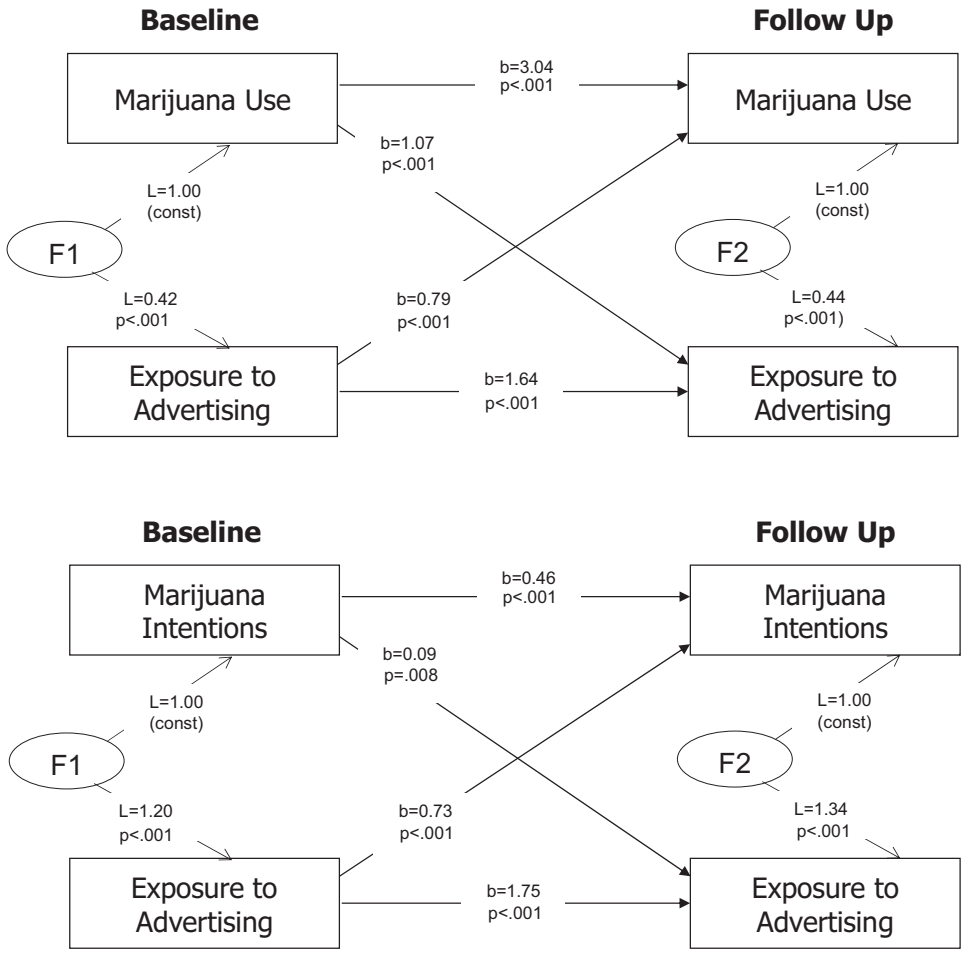

Figure 1. Cross-lagged regression models showing the longitudinal association between exposure to advertising and marijuana use, as well as exposure to advertising and marijuana intentions. F1 and F2 are latent variables used to represent the within-time covariance. Const. = constrained for identification purposes. Estimates are log(OR).

their actual marijuana use 1 year later. This is particularly important given that the mean age of our sample was 13 years, and initiation of marijuana use during early adolescence is associated with poor school performance, neuropsychological performance deficits, and further use of other illicit drugs, such as heroin and cocaine (Hall, 2009; Wittchen et al., 2008). Marijuana use in adolescence has also been linked with future problems in young adulthood, including increased risk for dependence (Ellickson, D'Amico, Collins, & Klein, 2005).

Given that advertising typically only tells one side of the story, prevention efforts must begin to better educate youth about medical marijuana while also emphasizing the negative effects that marijuana can have on the brain and performance (Lisdahl, Gilbart, Wright, & Shollenbarger, 2013; Medina et al., 2007). For example, in our intervention work with adolescents who have a first-time drug or alcohol offense, one of the sessions involves discussing how marijuana use can change the brain and affect memory and concentration (D'Amico, Hunter, Miles, Ewing, & Osilla, 2013). We found that addressing questions and discussing this type of information in a nonjudgmental way in the adolescent group setting can increase change talk, or talk that argues for decreasing marijuana use (D'Amico et al., 2015). This is important because change talk among can decrease initiation rates of both alcohol and marijuana use (Magill, Apodaca, Barnett, & Monti, 2010; Walker et al., 2011). In addition, prevention work with younger teens who have not yet initiated use has shown that discussing norms can decrease both initiation rates of alcohol and marijuana use (D'Amico & Edelen, 2007; D'Amico et al., 2012). Finally, programs could educate parents about medical marijuana so that they can better address questions that their teens may have regarding this drug; prevention programs have shown that when parents are more involved in their teens' lives, teens are less likely to use substances (Britt, Toomey, Dunsmuir, & Wagenaar, 2006; Scribner et al., 2008).

Of note, being a current marijuana user was strongly associated with adolescents' reports of seeing medical marijuana ads 1 year later. Youth who had higher intentions to use marijuana also reported seeing more ads. It may be that adolescents who use, or

are intending to use marijuana, report seeing more ads because they pay more attention to this type of advertising due to their interest in the drug and perhaps as a way to validate their use. For example, one study found that adolescents who used marijuana were more likely than nonusers to define marijuana as a "useful plant" and a "medical drug" and less likely to define it as an illegal drug (Plancherel et al., 2005). Furthermore, the *reinforcing spirals* model of media exposure and risk behavior indicates that exposure and behavior may be a mutually influencing process that could potentially increase participation in risk behaviors over time. For example, exposure to marijuana media content may influence youth to smoke marijuana, which may in turn increase the chances that they seek out marijuana media content as it fits with their interest in the drug. Support for this reciprocal model has been shown for adolescents' exposure to violent media content and aggression (Slater, 2007) and alcohol media content and drinking (Tucker et al., 2013).

As with most research of this nature, we relied on self-report from adolescents, the limitations of which are well known, although possibly exaggerated (Chan, 2008). We feel confident that our rates of use are accurate given that rates of marijuana use in our sample are similar to national norms (D'Amico et al., 2012). Furthermore, our study procedures (e.g., discussing confidentiality, using Scantrons, ensuring teachers were removed from data collection by having specific staff on the project collect surveys) provided a safe space for youth to complete their questionnaires. Another study limitation is that we only had two assessments that were spaced 1 year apart. Future work in this area could begin to examine this association over the long term with more frequent assessments as youth transition into high school and young adulthood. In addition, our measure of exposure was retrospective. We know of no validity checks or information relating to reports of exposure to advertising; however, this type of data collection is common in studies measuring advertising exposure (e.g., Anderson et al., 2009; Grenard et al., 2013; Rootman & Oakey, 1973). Of note, other methods, such as ecological momentary assessment (EMA), could be used to obtain more proximal data to gauge exposure to advertising (Scharf, Martino, Setodji, Staplefoote, & Shadel, 2013). EMA might be helpful for measuring daily exposure in this area, for example, particularly as different states begin the discussion of the legalization of marijuana, which may affect the amount of advertising that youth are exposed to in the United States. Many other potential variables also may have led to exposure to ads and/or marijuana use that we did not include in this study. For example, use of medical marijuana by a parent or by peers might have increased the chances that adolescents saw an advertisement and/or that they would subsequently use marijuana. Future work could include these variables to better tease apart these associations. In addition, research from the alcohol advertising literature over the past two decades has shown that there are more alcohol advertisements in low-income neighborhoods (Bryden, Roberts, McKee, & Petticrew, 2012; Merline, Jager, & Schulenberg, 2008). It is important to address whether certain geographic areas are also targeted for medical marijuana advertising.

Despite these limitations, results provide an important first look at the association of advertising for medical marijuana with younger adolescents' future marijuana use. Given the recent increase in media attention on marijuana, as well as the continuing changes in state laws regarding medical use of this drug, researchers must continue to assess how medical marijuana advertising may influence the way youth view marijuana and also how it may affect their usage of this drug. Researchers must also begin to think about the effects of advertising recreational marijuana as more states enact legislation legalizing recreational use. Because this is a new frontier, it is important to think about whether regulations should be put in place on medical marijuana and recreational marijuana advertising, similar to regulations that are in place for the advertising of alcohol and tobacco products.

In sum, professionals "on the front line" working with adolescents (e.g., pediatricians, clinicians, educators) must begin to educate young people about medical marijuana. First, they need to provide youth with an accurate understanding of what medical marijuana is and how it is used. This means explaining to youth that there are no efficacy studies for many conditions that marijuana is routinely used to treat. Furthermore, although there is some evidence that marijuana may help with certain ailments, much larger clinical trials with more varied groups of patients are needed (Sisson, 2014). It is also important to discuss the potential harms of this drug so youth understand how the drug may affect their developing brain and how the drug can affect performance in both adolescence and adulthood. Finally, from a public health standpoint, it is crucial that we begin to address regulatory standards for this industry given that it is in the early stages; we have a unique opportunity to shape the industry practices as legislation continues to evolve. This could help decrease potentially numerous problems similar to those that have occurred with both alcohol and tobacco advertising.

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