Exposure to ENDS advertising and use of marijuana in ENDS among college students

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Abstract

Background—Factors associated with marijuana use in electronic nicotine delivery systems (ENDS) are largely unknown. ENDS advertising, through subtle normative cues as well as explicit and implicit messages suggesting ENDS products are socially condoned and healthier alternatives, may influence the use of marijuana in ENDS. The aim of our study was to examine the association between exposure to ENDS advertising and subsequent use of ENDS with marijuana among college students.

Methods—Data for this study were from waves 2 and 4 of the Marketing and Promotions across Colleges in Texas (M-PACT) study. Participants included 3720 college students (*mean* age = 21.4, SD = 2.3; 35.78% white; 35.7% male) across 24 colleges in Texas who completed online tobacco behavior surveys one year apart. Multilevel logistic regression was conducted to examine the association between ENDS advertising exposure at wave 2 (spring 2015) and use of marijuana in ENDS one year later at wave 4 (spring 2016), controlling for age, sex, race/ethnicity, and wave 2 sensation-seeking, impulsivity, current tobacco use, current marijuana use, and ever use of ENDS with marijuana. Use of ENDS to consume marijuana in the past six months was the outcome variable and ENDS advertising exposure was the independent variable.

Results—Nearly half of participants reported ever ENDS use at waves 2 and 4, and 10% used marijuana in ENDS in the past 6-months at wave 4. Multilevel logistic regression analyses indicated that for every unit increase in ENDS advertising exposure, the odds of subsequently using ENDS with marijuana one year later were 1.08 times (95% CI = 1.01–1.14) greater.

Conclusions—ENDS advertising uniquely contributed to the subsequent use of marijuana in an ENDS, over and above the effects of other risk factors.

Keywords

Marijuana; Marketing; *E*-Cigarettes; ENDS; Advertising

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1. Introduction

Marijuana may be easily vaporized using electronic nicotine delivery systems (ENDS). In states with legal marijuana, cartridges filled with marijuana oil, made to fit commercially available ENDS, may be purchased at marijuana dispensaries. Additionally, users may fill these cartridges with home-made marijuana oil (Giroud et al., 2015). Only recently have researchers begun to examine the prevalence of marijuana use in ENDS among young adults. A 2016 sample of college students found 37% reported lifetime use of marijuana in ENDS and 22.5% reported past year use (Jones, Hill, Pardini, & Meier, 2016). A 2014 nationally representative study of young adults showed that 19.3% of ever marijuana users reported using marijuana in a vaporizer or other electronic device (Schauer, King, Bunnell, Promoff, & McAfee, 2016). While vaping may be useful for medicinal marijuana patients (Varlet et al., 2016), it remains important to understand factors that contribute to use of marijuana in ENDS in the overall young adult population, to whom marijuana use may be harmful.

Tobacco products have long been used for consuming marijuana (Sifaneck, Johnson, & Dunlap, 2006; Smith-Simone, Maziak, Ward, & Eissenberg, 2008). In fact, tobacco researchers have reported difficultly isolating cigar use from marijuana use as cigar products are heavily associated with "blunts" (Delnevo & Bover-Manderski, 2011; Hinds et al., 2016; Yerger, Pearson, & Malone, 2001). Some tobacco advertising capitalizes on the association between tobacco products and marijuana culture, branding with slang terms for marijuana (Crawford, 2007). Prior to ENDS entering the U.S. market in 2006, marijuana vaporizer advertising was rare outside the internet or specialty shops that sell other marijuana paraphernalia. However, ENDS advertising has moved vaporizers into conventional marketing channels.

Marketing is commonly practiced by use of a strategic mixture of product, price, place, and promotion with the goal of increasing purchases (McCarthy & Perreault, 1960). Advertisements, one component of marketing, are meant to shape consumer's beliefs and attitudes toward a product. Many theories posit that advertisements influence consumers' attitudes through either the peripheral or central route of persuasion (Petty & Cacioppo, 1983). The central route involves active participation by consumers, namely, weighing advantages and disadvantages of a product, shaping an individual's attitude toward the product. Alternatively, the peripheral route changes attitudes with subtle cues, either positive or negative, such as an expert source of information. For example, juxtaposition of smoking and vaping (de Andrade, Hastings, & Angus, 2013; Willis, Haught, & Morris II, 2016) may shape consumers' attitudes toward ENDS as a healthier alternative to smoking tobacco through the central route of persuasion. Placement of ENDS advertising in magazines may provide subtle normative cues indicating that these products are socially condoned. In sum, the central and peripheral routes of persuasion provide a useful model to understand how exposure to ENDS advertising shapes perceptions.

While the central and peripheral routes of persuasion shed light on how advertising messages are processed, framing theory assists with analysis of the messaging content of

advertisements. In their analysis of ENDS advertisements on YouTube, Willis et al. (2016) used framing theory to assess how ENDS are marketed to the public. Components used to frame advertisement messages include word choice, metaphors, exemplars, descriptions, and images (Gamson & Modigliani, 1989). Some of these framing components may be particularly associated with marijuana use in ENDS. For example, ENDS were widely framed as favorable alternatives to cigarettes, including messages that emphasize the decreased smell compared to cigarettes and the ability to use ENDS where cigarettes are prohibited (Willis et al., 2016). Advertisements also stressed the social acceptability and reduced harmfulness of ENDS compared to cigarettes (de Andrade et al., 2013; Willis et al., 2016). These ENDS advertising frames may transfer to attitudes toward conventional smoking of marijuana and influence use marijuana in ENDS.

It is unclear if exposure to ENDS advertising contributes to the use of marijuana in ENDS. However, studies have made clear that exposure to traditional tobacco and ENDS product advertising influences use among adolescent and young adult (Biener & Siegel, 2000; Dalton et al., 2009; Gilpin, White, & Messer, 2007; Pierce et al., 2018; Soneji, Ambrose, Lee, Sargent, & Tanski, 2014; Villanti et al., 2016). Additionally, the reported reasons users vape rather than smoke marijuana are the same reasons tobacco users report using ENDS rather than cigarettes (Etter, 2015; Giroud et al., 2015; Malouff, Rooke, & Copeland, 2014; Pepper & Brewer, 2014). For instance, many tobacco users report harm reduction as a reason for using ENDS (Pepper & Brewer, 2014). Marijuana users also report switching from smoking to vaporizing in order to reduce harm (Etter, 2015; Giroud et al., 2015; Malouff et al., 2014). These reasons correspond with ENDS advertisement messages (Willis et al., 2016) and exposure to ENDS advertising has been shown to influence attitudes and susceptibility toward ENDS (Pokhrel, Fagan, Herzog, & Chen, 2016; Pokhrel, Herzog, Fagan, Unger, & Stacy, 2018). Research is needed to assess the influence of exposure to ENDS advertising and marijuana use in ENDS over time. Therefore, the purpose of this study was to examine the association between exposure to ENDS advertising and subsequent use of marijuana in ENDS among young adults one year after exposure.

2. Methods

2.1. Participants

The 3720 students comprising the current sample participated in waves 2 and 4 (spring 2015 and 2016, respectively) of a larger study, the Marketing and Promotions across Colleges in Texas project (M-PACT). M-PACT is a rapid response, web-based surveillance survey assessing the tobacco use behaviors of a cohort of young adult students attending one of 24 universities or vocational schools in the five largest metropolitan areas of Texas (Austin, Dallas/Ft. Worth, Houston, and San Antonio). At wave 2, participants were approximately 35% male, 21.4 years of age (SD = 2.3 years), and 36% non-Hispanic White (see Table 1). Over 93% were attendees of 4-year colleges or universities.

To participate in M-PACT, students had to be degree- or certificate-seeking, full- or part-time students at one of 24 colleges/universities. After obtaining contact records, students at these 24 colleges or universities were sent email invitations to participate in the study. After clicking on a hyperlink in the email and proceeding past the informed consent page,

participants were asked questions related to inclusion criteria. If eligible, they were then advanced to a screen with the online survey. Additional M-PACT sampling procedure details have been detailed elsewhere (Bandiera, Loukas, Wilkinson, & Perry, 2016; Hinds et al., 2016; Loukas et al., 2016). The 3720 participants comprising the present study sample participated in data collection during waves 2 and 4 of M-PACT and provided complete data for all predictor variables and covariates. Current marijuana users had significantly lower odds of inclusion in the current study sample than those in the larger wave 2 sample (OR = 0.72, 95% CI = 0.56–0.93). There were no significant differences in race/ethnicity, age, biological sex, wave 2 ever marijuana use in ENDS, tobacco use, sensation seeking, impulsivity, or ENDS marketing exposure between participants included in the study sample and those who were dropped because of missing data in wave 4.

2.2. Procedure

More than 13,000 students were eligible to participate in the study and 5482 students (40%) provided consent and completed the baseline survey. Of the 5482 participants in the baseline cohort, 79% were retained in wave 2, and 81% were retained in wave 4 (after one year). The current study focuses on the ENDS and marijuana use behaviors of the 3720 participants who took part in waves 2 and 4. Data were not available in wave 1 to address the research question.

2.3. Measures

2.3.1. ENDS advertising exposure—Past 30-day ENDS marketing exposure was assessed by asking participants about exposure at locations and media channels. "Where do you remember seeing or hearing advertisements for ENDS products (i.e. e-cigarettes, vape pens, or e-hookah)?" Participants were instructed to check all that apply among a) "Gas stations, convenience stores, drug stores (e.g. Walgreens) or grocery stores," b) "Liquor Stores," c) "Bars/Clubs," d) "Music Events/Festivals," or e) "None of these locations." Channel exposure answer options included a) "Radio/Internet Radio," b) "Internet/Online," c) "Magazines/Newspapers," d) "Billboards," or e) "None of these locations." A composite score for ENDS exposure was created by summing the total number of endorsed locations and channels. This variable had values ranging from 0 to 8. This measure was adapted from previous studies that examined tobacco marketing exposure (Feighery, Borzekowski, & Schooler, 1998; MacFadyen, Hastings, & MacKintosh, 2001; Schooler, Feighery, & Flora, 1996).

2.3.2. Past 6-months marijuana use in ENDS—In wave 4, respondents were asked, "In the past 6 months, i.e. since the last survey you took, have you smoked marijuana in an ENDS product (i.e. e-cigarette, vape pen, e-hookah, personal vaporizer, or mod)?" response options included yes (1) or no (0).

2.4. Covariates

2.4.1. Sociodemographic characteristics—Sociodemographic characteristics were assessed at the baseline wave of M-PACT (fall, 2014). Current age was the only continuous variable, biological sex was coded as male (1), or female (0). Race/ethnicity was treated as a dichotomous variable, with non-Hispanic white participants coded as 1, and other races/

ethnicities or multiple races/ethnicities coded as 0. School type was either a 4-year college/ university (1), or 2-year vocational school (0).

2.4.2. Ever use of marijuana in ENDS—Ever use of marijuana in an ENDS was assessed with a single question at wave 2, "Have you ever smoked marijuana in an ENDS product? (i.e. e-cigarette, vape pen, or e-hookah)" response options included yes (1) or no (0).

2.4.3. Current tobacco use—Current tobacco use was measured at wave 2 with four separate questions assessing use of cigarettes, cigars, smokeless tobacco, and hookah within the past 30 days (e.g. "On how many of the past 30 days have you smoked a hookah as intended?"). Pictures depicting each type of tobacco product were placed at the beginning of each product section. For example, a picture of a hookah followed the general description of hookah, after which participants were asked on how many of the past 30 days they used any hookah like the ones in the photograph. Students who reported using any product at least one day in the past month were considered a current tobacco user (1) otherwise they were coded as non-users (0).

2.4.4. Ever ENDS use—At both waves 2 and 4, ever use of ENDS was established by asking participants, "Have you ever used an ENDS product, (i.e. e-cigarette, vape pen, e-hookah, or mod) as intended (i.e. with nicotine cartridges and/or e-juice), even one or two puffs?" Responses included yes (1) or no (0). Similar to the tobacco use questions, an image was included that depicted several styles of ENDS at the start of the section about ENDS use.

2.4.5. Current ENDS use—At both waves 2 and 4, current (past-30 day) use of ENDS was ascertained by asking any participant who reported ever using an ENDS the question, "How many of the past 30 days have you used any ENDS product (i.e. an e-cigarette, vape pen, e-hookah, or mod), even one or two puffs, as intended (i.e. with nicotine cartridges and/or e-liquid/e-juice)?" Students who reported between 1 and 30 days were coded 1 versus zero days 0.

2.4.6. Marijuana use—At each wave, current (past 30-day) use of marijuana was assessed by asking, "During the past 30 days, how many occasions, or times, if any, have you used marijuana? (Other names for marijuana are pot and weed)." Answer responses included "0 times," "1–2 times," "3–5 times," "6–9 times," "10–19 times," "20–39 times," and "40 or more times." Students who reported at least 1–2 times were coded as 1 versus zero times 0.

2.4.7. Sensation seeking and impulsivity—We used Stephenson and colleagues' modified 4-item version of the Brief Sensation-Seeking Scale (BSSS-4) (2003). We assessed impulsivity using a modified 3-item version subscale of Krank and colleagues' Substance Use Risk Profile Scale (SURPS) (2011). Both scales use Likert scales ranging from 1 ("strongly disagree") to 5 ("strongly agree") for questions like "I would like to explore strange places," or "I usually act without stopping to think." We created mean sensation seeking and impulsivity scores per participant using their wave 2 data. Sensation seeking

and impulsivity were included as covariates due to past findings that demonstrated correlations with marijuana use (Suerken et al., 2016; Vangsness, Bry, & LaBouvie, 2005) and ENDS use (Spindle et al., 2017; Sutfin et al., 2015) among college students.

2.5. Data analysis

We tested the association between ENDS advertising exposure and later use of marijuana in an ENDS using multilevel logistic regression with STATA (StataCorp, 2015). The longitudinal analysis accommodated the clustering of students in the 24 colleges by using college as a random effect. Using marijuana in an ENDS in the past 6 months (wave 4) served as the outcome variable. Exposure to ENDS advertising one-year prior (at wave 2) served as the predictor variable and covariates included age, sex, race/ethnicity, college type (2-year vs. 4-year), sensation seeking, impulsivity, current tobacco use, current marijuana use, and ever use of marijuana in an ENDS.

3. Results

At wave 2, almost half of the study sample reported ever using ENDS, and 14% used ENDS in the past 30 days. Around 22% of the sample reported currently using marijuana and had ever used marijuana in an ENDS at wave 2 (see Table 1). At wave 4, over half of the sample reported ever using an ENDS, while current (past 30-day) ENDS use dropped to 10%. Approximately one quarter of participants (23.1%) reported current marijuana use at wave 4, and 10% of the sample used marijuana in an ENDS in the past 6 months. Overall, 28.6% of the sample had ever used marijuana in an ENDS by wave 4. Convenience, grocery, and drug stores were the most heavily endorsed locations for ENDS marketing exposure, followed by the media channels of the internet and in magazines (see Table 2). On average, participants were exposed to almost three channels or locations with ENDS marketing at least once in the past month (mean = 2.74, SD = 2.0).

3.1.1. ENDS advertising and the use of marijuana in an ENDS

Multilevel binary logistic regression analyses indicated that for every one unit increase in ENDS advertising exposure at wave 2, the odds of a participant subsequently using ENDS to consume marijuana one year later was 1.08 greater (95% CI = 1.01–1.14; see Table 3). ENDS advertisement exposure increased the risk of using ENDS to consume marijuana above and beyond current marijuana use, ever use of marijuana in an ENDS, current tobacco use, sex, and impulsivity.

4. Discussion

Our study is the first to examine the longitudinal association between exposure to ENDS advertising and subsequent marijuana use in ENDS among young adults. Our survey had a relatively high number of participants (over 55%) who reported ever using ENDS relative to previous research. For instance, a representative sample of young adults in 2013 and 2014 indicated over 12% used ENDS in the past 30 days (Kasza et al., 2017). However, our sample had a similar proportion of participants who reported ever using marijuana in a vaporizer as previous studies (22% and 19.3%, respectively; Schauer et al., 2016). Further,

we found that exposure to ENDS advertising was associated with use of marijuana in ENDS one year later. Although the odds ratio was not as large as the odds ratio for the other significant risk factors (e.g. past marijuana use), ENDS advertising uniquely contributed to the subsequent use of marijuana in ENDS over and above the effects of other risk factors including impulsivity and sensation seeking, which are demonstrated correlates of marijuana use (Suerken et al., 2016; Vangsness et al., 2005). These findings suggest ENDS advertisements are influencing college students to use marijuana in ENDS, a long-lasting effect found a year after exposure.

The introduction of ENDS to the U.S. market has led to a rise in ENDS advertising across multiple channels (Basch, Mongiovi, Hillyer, Ethan, & Hammond, 2016; Duke et al., 2014; Ganz et al., 2015; Kim, Arnold, & Makarenko, 2014; Wagoner et al., 2014). Our findings indicate exposure to ENDS advertising across multiple channels and locations predicts marijuana use in ENDS. Previous research has documented the linking of marijuana and tobacco in tobacco marketing and common use of marijuana in tobacco products (Crawford, 2007; Delnevo & Bover-Manderski, 2011; Hinds et al., 2016; Sifaneck et al., 2006; Smith-Simone et al., 2008). A potentially problematic and understudied effect of the cross-promotion of tobacco with marijuana-related content is the dual use of these products, a relatively common practice among young adults (Kennedy, Caraballo, Rolle, & Rock, 2016). Given these studies and our findings, future research should focus on marketing messages that associate ENDS with marijuana and with other tobacco products to determine their influence on the co-use of marijuana and tobacco.

While our study has important findings, it is not without limitations. Participants were college students in Texas, and were overrepresented by female participants, therefore, generalizability of our findings may be limited. Similar to many longitudinal studies focused on substance use, marijuana users were less likely to have been included in the present study. Future work with larger samples of young adults, including those who do not attend college, are needed. Additionally, we did not examine the content or frequency of exposure to ENDS advertisements that students are reportedly seeing. Future research may examine the influence of frequency of exposure and content of ENDS advertisements and the influence on attitudes toward marijuana use in ENDS. Despite these limitations, our study is the first to find exposure to ENDS advertising is influencing college students to use marijuana in ENDS, a finding that has potentially increasing importance as more states legalize marijuana.

5. Conclusions

Recreational marijuana is now legal in a total of nine states and the District of Columbia as of July 2018 (Robinson & Berke, 2018). Alongside legalization, more youth and young adults report exposure to advertising and use of ENDS (Arrazola et al., 2015; Duke et al., 2014; McMillen, Gottlieb, Shaefer, Winickoff, & Klein, 2015). While there is evidence that vaporizing marijuana may be less harmful than inhaling smoke (Varlet et al., 2016), it is important to prevent youth initiation and delay use among young adults whose brains may still be developing. In sum, widespread marketing of ENDS and use of marijuana in ENDS is a new phenomenon that requires robust research to inform policymakers, other

researchers, and the public who are concerned with preventing youth and young adult marijuana use.

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References

de Andrade M, Hastings G, & Angus K (2013). Promotion of electronic cigarettes: Tobacco marketing reinvented? BMJ, 347 10.1136/bmj.f7473.

Arrazola RA, Singh T, Corey CG, Husten CG, Neff LJ, Apelberg BJ, … Centers for Disease Control and Prevention (CDC) (2015). Tobacco use among middle and high school students - United States, 2011–2014. MMWR. Morbidity and Mortality Weekly Report, 64(14), 381–385. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/25879896. [PubMed: 25879896]

Bandiera FC, Loukas A, Wilkinson AV, & Perry CL (2016). Associations between tobacco and nicotine product use and depressive symptoms among college students in Texas. Addictive behaviors, 63, 19–22. [PubMed: 27393934]

Basch C, Mongiovi J, Hillyer G, Ethan D, & Hammond R (2016). An analysis of electronic cigarette and cigarette advertising in US women's magazines. International Journal of Preventive Medicine, 7(1), 103 10.4103/2008-7802.190089. [PubMed: 27688867]

Biener L, & Siegel M (2000). Tobacco Marketing and Adolescent smoking: More support for a Causal Inference. American Journal of Public Health, 40790(3), 407–411. Retrieved from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1446173/pdf/10705860.pdf.

Crawford GE (2007). Flavoured tobacco products with marijuana names. Tobacco Control, 16(1), 70 10.1136/tc.2006.018267.

Dalton MA, Beach ML, Adachi-Mejia AM, Longacre MR, Matzkin AL, Sargent JD, … Titus-Ernstoff L (2009). Early exposure to movie smoking predicts established smoking by older teens and Young adults. Pediatrics, 123(4), Retrieved from http://pediatrics.aappublications.org/content/123/4/e551.short.

Delnevo C, & Bover-Manderski M (2011). Cigar, marijuana, and blunt use among US adolescents: Are we accurately estimating the prevalence of cigar smoking among youth? Preventive Retrieved from http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3139401/.

Duke JC, Lee YO, Kim AE, Watson KA, Arnold KY, Nonnemaker JM, & Porter L (2014). Exposure to electronic cigarette television advertisements among youth and young adults. Pediatrics, 134(1), e29–e36. [PubMed: 24918224]

Etter J-F (2015). Electronic cigarettes and cannabis: An exploratory study. European Addiction Research, 21(3), 124–130. 10.1159/000369791. [PubMed: 25613866]

Feighery E, Borzekowski D, & Schooler C (1998). Seeing, wanting, owning: The relationship between receptivity to tobacco marketing and smoking susceptibility in young people. Tobacco Control 7(2), 123–128. Retrieved from http://tobaccocontrol.bmj.com/content/7/2/123.short. [PubMed: 9789929]

Gamson WA, & Modigliani A (1989). Media discourse and public opinion on nuclear power: a constructionist approach. American Journal of Sociology, 95(1), 1–37. 10.1086/229213.

Ganz O, Cantrell J, Moon-Howard J, Aidala A, Kirchner TR, & Vallone D (2015). Electronic cigarette advertising at the point-of-sale: A gap in tobacco control research. Tobacco Control. 10.1136/tobaccocontrol-2013-051337.

Gilpin E, White M, & Messer K (2007). Receptivity to tobacco advertising and promotions among young adolescents as a predictor of established smoking in young adulthood. American Journal of Public Health 97(8), 1489–1495. Retrieved from http://ajph.aphapublications.org/doi/abs/10.2105/AJPH.2005.070359. [PubMed: 17600271]

Giroud C, de Cesare M, Berthet A, Varlet V, Concha-Lozano N, & Favrat B (2015). E-cgarettes: A review of new trends in cannabis use. International Journal of Environmental Research and Public Health, 12(8), 9988–10008. 10.3390/ijerph120809988. [PubMed: 26308021]

Hinds JT, Loukas A, Chow S, Pasch KE, Harrell MB, Perry CL, … Wackowski OA (2016). Using cognitive interviewing to better assess young adult e-cigarette use. Nicotine and Tobacco Research, 18(10), 1998–2005. 10.1093/ntr/ntw096. [PubMed: 27029822]

Jones CB, Hill ML, Pardini DA, & Meier MH (2016). Prevalence and correlates of vaping cannabis in a sample of young adults. Psychology of Addictive Behaviors, 30(8), 915–921. 10.1037/adb0000217. [PubMed: 27631612]

Kasza KA, Ambrose BK, Conway KP, Borek N, Taylor K, Goniewicz ML, … Hyland AJ (2017). Tobacco-product use by adults and youths in the United States in 2013 and 2014. New England Journal of Medicine, 376(4), 342–353. 10.1056/NEJMsa1607538. [PubMed: 28121512]

Kennedy SM, Caraballo RS, Rolle IV, & Rock VJ (2016). Not just cigarettes: A more comprehensive look at marijuana and tobacco use among african american and white youth and young adults. Nicotine & Tobacco Research, 1(Suppl. 1), S65–S72. 10.1093/ntr/ntv202.

Kim AE, Arnold KY, & Makarenko O (2014). E-cigarette advertising expenditures in the U.S., 2011–2012. American Journal of Preventive Medicine, 46(4), 409–412. 10.1016/j.amepre.2013.11.003. [PubMed: 24650844]

Loukas A, Chow S, Pasch KE, Li X, Hinds III, Josephine T, & Perry CL (2016). College students' polytobacco use, cigarette cessation, and dependence. American journal of health behavior, 40(4), 514–522. [PubMed: 27338998]

MacFadyen L, Hastings G, & MacKintosh AM (2001). Cross sectional study of young people's awareness of and involvement with tobacco marketing. BMJ, 322(7285), Retrieved from http://www.bmj.com/content/322/7285/513.short.

Malouff JM, Rooke SE, & Copeland J (2014). Experiences of marijuana-vaporizer users. Substance Abuse, 35(2), 127–128. 10.1080/08897077.2013.823902. [PubMed: 24821347]

McCarthy JE, & Perreault WD (1960). Basic Marketing Homewood, IL: Richard D.

McMillen RC, Gottlieb MA, Shaefer RMW, Winickoff JP, & Klein JD (2015). Trends in electronic cigarette use among U.S. adults: Use is increasing in both smokers and nonsmokers. Nicotine & Tobacco Research: Official Journal of the Society for Research on Nicotine and Tobacco, 17(10), 1195–1202. 10.1093/ntr/ntu213. [PubMed: 25381306]

Pepper JK, & Brewer NT (2014). Electronic nicotine delivery system (electronic cigarette) awareness, use, reactions and beliefs: A systematic review. Tobacco Control, 23(5), 375–384. 10.1136/tobaccocontrol-2013-051122. [PubMed: 24259045]

Petty R, & Cacioppo J (1983). Central and peripheral routes to advertising effectiveness: The moderating role of involvement. Journal of Consumer Research 10(2), 135–146. Retrieved from https://academic.oup.com/jcr/article-abstract/10/2/135/1801204.

Pierce JP, Sargent JD, Portnoy DB, White M, Noble M, Kealey S, … Hyland A (2018). Association between receptivity to tobacco advertising and progression to tobacco use in youth and young adults in the PATH Study. JAMA Pediatrics. 10.1001/jamapediatrics.2017.5756.

Pokhrel P, Fagan P, Herzog T, & Chen Q (2016). E-cigarette advertising exposure and implicit attitudes among young adult non-smokers. Drug and Alcohol Retrieved from http://www.sciencedirect.com/science/article/pii/S0376871616300357.

Pokhrel P, Herzog T, Fagan P, Unger J, & Stacy A (2018). E-cigarette advertising exposure, explicit and implicit harm perceptions, and E-cigarette use susceptibility among nonsmoking young adults. Nicotine & Tobacco Research. 10.1093/ntr/nty030.

Robinson M, & Berke J (2018). Where you can legally have marijuana in the US in 2018-Business Insider. Business Insider Retrieved from http://www.businessinsider.com/where-can-you-can-legally-smoke-weed-2018-1.

Schauer GL, King BA, Bunnell RE, Promoff G, & McAfee TA (2016). Toking, vaping, and eating for health or fun: marijuana use patterns in adults, U.S., 2014. American Journal of Preventive Medicine, 50(1), 1–8. 10.1016/j.amepre.2015.05.027. [PubMed: 26277652]

Schooler C, Feighery E, & Flora JA (1996). Seventh graders' self-reported exposure to cigarette marketing and its relationship to their smoking behavior. American Journal of Public Health, 86(9), 1216–1221. 10.2105/AJPH.86.9.1216. [PubMed: 8806371]

Sifaneck SJ, Johnson BD, & Dunlap E (2006). Cigars-for-blunts. Journal of Ethnicity in Substance Abuse, 4(3–4), 23–42. 10.1300/J233v04n03_02.

Smith-Simone S, Maziak W, Ward KD, & Eissenberg T (2008). Waterpipe tobacco smoking: Knowledge, attitudes, beliefs, and behavior in two U.S. samples. Nicotine & Tobacco Research : Official Journal of the Society for Research on Nicotine and Tobacco, 10(2), 393–398. 10.1080/14622200701825023. [PubMed: 18236304]

Soneji S, Ambrose BK, Lee W, Sargent J, & Tanski S (2014). Direct-to-consumer tobacco marketing and its association with tobacco use among adolescents and young adults. Journal of Adolescent Health, 55(2), 209–215. 10.1016/j.jadohealth.2014.01.019. [PubMed: 24661738]

Spindle TR, Hiler MM, Cooke ME, Eissenberg T, Kendler KS, & Dick DM (2017). Electronic cigarette use and uptake of cigarette smoking: A longitudinal examination of U.S. college students. Addictive Behaviors. 10.1016/j.addbeh.2016.12.009.

StataCorp (2015). Stata Statistical Software: Release 14 College Station, TX: StatCorp LP.

Suerken CK, Reboussin BA, Egan KL, Sutfin EL, Wagoner KG, Spangler J, & Wolfson M (2016). Marijuana use trajectories and academic outcomes among college students. Drug and Alcohol Dependence, 162, 137–145. 10.1016/j.drugalcdep.2016.02.041. [PubMed: 27020322]

Sutfin EL, Reboussin BA, Debinski B, Wagoner KG, Spangler J, & Wolfson M (2015). The impact of trying electronic cigarettes on cigarette smoking by college students: A prospective analysis. American Journal of Public Health, 105(8), e83–e89. 10.2105/AJPH.2015.302707.

Vangsness L, Bry BH, & LaBouvie EW (2005). Impulsivity, negative expectancies, and marijuana use: A test of the acquired preparedness model. Addictive Behaviors, 30(5), 1071–1076. 10.1016/j.addbeh.2004.11.003. [PubMed: 15893107]

Varlet V, Concha-Lozano N, Berthet A, Plateel G, Favrat B, De Cesare M, & Giroud C (2016). Drug vaping applied to cannabis: Is "Cannavaping" a therapeutic alternative to marijuana? Scientific Reports, 6, 25599 10.1038/srep25599. [PubMed: 27228348]

Villanti AC, Rath JM, Williams VF, Pearson JL, Richardson A, Abrams DB, … Vallone DM (2016). Impact of exposure to electronic cigarette advertising on susceptibility and trial of electronic cigarettes and cigarettes in US young adults: a randomized controlled trial. Nicotine & Tobacco Research, 18(5), 1331–1339. 10.1093/ntr/ntv235. [PubMed: 26574551]

Wagoner KG, Song EY, Egan KL, Sutfin EL, Reboussin BA, Spangler J, & Wolfson M (2014). E-cigarette availability and promotion among retail outlets near college campuses in two southeastern states. Nicotine & Tobacco Research : Official Journal of the Society for Research on Nicotine and Tobacco, 16(8), 1150–1155. 10.1093/ntr/ntu081. [PubMed: 24847099]

Willis E, Haught MJ, & Morris DL II (2016). Up in vapor: Exploring the health messages of E-cigarette advertisements. Health Communication, 1–9. 10.1080/10410236.2016.1138388.

Yerger V, Pearson C, & Malone RE (2001). When is a cigar not a cigar? African American youths' understanding of "cigar" use. American Journal of Public Health, 91(2), 316–317. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/11211649. [PubMed: 11211649]

HIGHLIGHTS

- Beyond nicotine, ENDS advertising predicted marijuana use in ENDS a year later

- Each additional location or channel of exposure increased odds of marijuana use in ENDS by 8%

- ENDS advertising predicted marijuana use in ENDS, even controlling for tobacco use, marijuana use, and sensation seeking/impulsivity

- A majority reported seeing ENDS marketing at convenience stores or on the internet

- Heavy marijuana users were more likely to use marijuana in ENDS

Table 1

Socio-demographic characteristics and ENDS use behaviors (N = 3720).

Mean age in years (SD)	21.4 (2.3)	
Sex (% male)	35.7	
Race/Ethnicity	–	
% White	35.8	
% Hispanic	30.2	
% Asian	19.5	
% Black	7.1	
% Other / Multiple	7.4	
School Type (% 4-year University)	93.3	
ENDS and Marijuana Use Behaviors	Wave 2	Wave 4
Ever used ENDS device	48.6%	54.41%
Past 30-day ENDS use	14.5%	10.4%
Past 6-months use of marijuana in ENDS	–	10.0%
Past 6-months	22.2%	23.1%
Ever use of marijuana in ENDS	21.6%	28.62%

Table 2

Reported past 30-day e-cigarette ad exposure by location or channel and wave (N = 3720).

	Wave 2	Wave 4
Convenience/grocery/drug stores	63.4%	58.4%
Internet	52.0%	43.1%
Magazine	36.0%	26.5%
Radio	29.7%	23.7%
Billboard	26.2%	22.0%
Music Festivals/Outdoor Events	25.0%	22.2%
Bars/Clubs	22.1%	20.9%
Liquor Stores	20.2%	20.0%

Table 3

Multilevel binary logistic regression models predicting past six-months' use of marijuana in an ENDS among college students (N = 3720).

	OR	95% CI
W2 ENDS marketing exposure index	**1.08**	**1.01–1.14**
Age	0.90	0.80–1.01
Male sex (vs. female)	**1.41**	**1.11–1.79**
White Race (vs. non-white)	1.03	0.81–1.32
W2 ever use of marijuana in ENDS	**3.37**	**2.59–4.38**
W2 tobacco use	**1.84**	**1.43–2.36**
W2 current marijuana use[a]	**2.65**	**2.02–3.48**
1–2 times	**1.55**	**1.06–2.26**
3–5 times	**2.23**	**1.37–3.64**
6–9 times	**2.79**	**1.58–4.93**
10–19 times	**4.39**	**2.66–7.24**
20–39 times	**6.09**	**3.45–10.77**
40 or more	**4.70**	**3.00–7.36**
Sensation seeking	1.00	0.88–1.14
Impulsivity	**1.18**	**1.03–1.35**

Note: Both multilevel models accommodated clustering of students within the 24 schools. W2 = wave two was conducted in the spring of 2015 and the outcome was measured at wave 4 in the spring of 2016.

Bold values indicate Odds Ratios that are significantly different than zero and p-values < .05

[a]OR = 2.65 corresponds to the overall association between W2 current marijuana use and past six-months marijuana use in ENDS (e.g. average OR for one unit change in the predictor) while each group's (e.g., 1–2 times) OR are the odds of past six-months marijuana use in ENDS compared to students who reported use of marijuana "0 times" in the past month at W2.