



HHS Public Access

Author manuscript

Prev Sci. Author manuscript; available in PMC 2019 February 01.

Published in final edited form as:

Prev Sci. 2018 February ; 19(2): 127–137. doi:10.1007/s11121-017-0818-9.

Exposure to and content of marijuana product reviews

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Abstract

Introduction—Many individuals now seek out product reviews in order to make an informed decision prior to making a purchase. In this study, we investigate consumers' exposure to and content within product reviews about marijuana because of their potential to shape marijuana purchasing decisions.

Methods—The terms “weed review”, “marijuana review”, and “cannabis review” were searched on YouTube on June 10–11, 2015; the team viewed and coded the content of 83 product review videos about marijuana. In addition, we surveyed young adult (18–34 years old) current (past month) marijuana users (n=742) from across the U.S. online to assess exposure to product reviews about marijuana and associations with socio-demographic characteristics and marijuana use behaviors.

Results—In our content analysis of videos, we observed that the reviewers tended to consume marijuana during the video and often shared personal, favorable experiences towards the marijuana they ingested (e.g., became as high as possible or experienced positive effects on physical and mental health). Most videos normalized marijuana use and could be easily accessed by underage youth. About 1/3 (34%) of the survey participants viewed/sought a product review about marijuana in the past 30 days. In a multivariable logistic regression model, living in a state where recreational use is legal or using multiple forms of marijuana was associated with increased odds of viewing/seeking marijuana reviews.

Conclusions—Prevention messages should counter product reviews about marijuana that tend to normalize and promote marijuana use given that they are more readily viewed by individuals who are increasingly susceptible to marijuana's potential harms.

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Conflict of Interest Disclosure

Dr. Bierut, is listed as an inventor on Issued U.S. Patent 8, 080, 371, “Markers for Addiction,” covering the use of certain SNPs in determining the diagnosis, prognosis, and treatment of addiction. All other authors declare that they have no conflict of interest.

Ethical approval

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent

Informed consent was obtained from all individual participants included in the Study 1. Study 2 was reviewed by the Washington University Human Research Protection Office and granted a non-human determination. Therefore, consent was not needed for this study.

Keywords

Social networking; internet advertising; substance abuse and addiction

In 2012, marijuana was legalized for recreational use in Colorado. Since then, seven additional states (Alaska, California, Maine, Massachusetts, Nevada, Oregon, Washington) and the District of Columbia have legalized recreational marijuana, and many other states have medical use, decriminalization laws, or both (NORML, 2017). The legal (recreational and medical) marijuana industry continues to rapidly expand, with retail and wholesale sales increasing from \$2.7 billion in 2014 to \$6.9 billion in 2016 making it one of the fastest growing industries in the U.S. (ArcView Market Research, 2017). As the marijuana industry becomes commercialized, there is great potential for an influx of marijuana-related products to emerge.

Product reviews are created by individuals who relay a personal experience following their consumption of a product, often with a primary intent of providing helpful information regarding that product's quality to other potential customers. It has become commonplace for individuals to regard product reviews as a resource to learn about someone's experience with a product, and to help make an informed purchasing decision. Market research indicates that most consumers will make a purchase, and even buy products not being considered, when they are inspired by a favorable product review (Weber Shandwick, 2013). This is especially the case when there is a multitude of products to differentiate between and/or new products emerging in the market (Kostyra, Reiner, Natter, & Klapper, 2016). As a result, product reviews are widespread across multiple media venues and have been described as "*important sources of information for modern consumers*" (Racherla & Friske, 2012). Product reviews also inform consumers of licit emerging substances (e.g., newly-launched alcohol products; Chevalier & Mayzlin, 2006; Clemons, Gao, & Hitt, 2006; Dellarocas, Awad, & Zhang, 2005; Hu, Liu, & Zhang, 2008), and could potentially influence the purchasing decisions of marijuana consumers.

Understanding the extent and impact of marijuana promotions in general and on social media, in particular, where young people often frequent is an emerging area of research. D'Amico et al. (2015) found that exposure to medical marijuana advertisements resulted in a higher probability of its use and suggests the possibility that commercial promotions may shift norms about marijuana as a deviant behavior towards increased acceptance of its use. Supporting this notion, the normalization framework has been recently acknowledged as a useful theory to explain how the marijuana macro-environmental changes that are currently underway via legalization and commercialization have potential for shifting attitudes from viewing marijuana as an aberrant behavior towards permissiveness of marijuana experimentation and use (Sznitman & Taubman, 2016). Specifically, the normalization framework conceptualizes a population-level attitudinal shift from viewing illicit drug use as a deviant and stigmatizing behavior towards perceiving its use to be as acceptable as the use of legal drugs (i.e., alcohol use) (Sandberg, 2012). To this end, the current study is guided by the normalization framework that considers media messages to be an important factor that can drive the "cultural accommodation" of illicit drug use (Sznitman, 2007).

In our prior work, we found YouTube videos about high-potency marijuana (i.e. dabbing marijuana concentrates) were widely viewed (i.e. 116 videos had a total of nearly 10 million views), primarily encouraged marijuana use and rarely utilized age restrictions; over one-third of the YouTube videos were identified as user-generated online reviews about a specific marijuana product or marijuana retailer (Krauss et al., 2015a). Despite this, very little is known about the exposure to and the content of marijuana product reviews consulted by marijuana users, even with an expanding marijuana industry and an influx of novel marijuana-related products emerging into the market.

In the present study, we move this field forward with a content analysis of user-generated reviews about marijuana that exist on YouTube. YouTube is the most popular online video-sharing channel, and the third most visited website in the world following Google and Facebook (McGoogan, 2016; YouTube, 2015a). Driving its popularity is the ease in which millions of people use YouTube to upload their homemade videos and share them freely and readily with others around the world (YouTube, 2015a). YouTube is especially relevant to hone in on for improved understanding of user-generated online reviews about marijuana because this platform in particular has been depicted as a “heavily utilized” venue for spreading information and (unmonitored) promotional messages about substances including e-cigarettes and alcohol (Cranwell et al., 2015; Huang, Kornfield, & Emery, 2016; Paek et al., 2014; Primack et al., 2015; Seidenberg, Rees, & Connolly, 2010; Winpenny, Marteau, & Nolte, 2014). In the current study, we present two investigations that converge towards improving knowledge about online reviews about marijuana. In Study 1, we employ a systematic study of the content of user-generated online reviews about marijuana portrayed on YouTube, because it is an important channel of information with its status as the most popular video social media site having acquired over one billion subscribers (YouTube, 2015a). Driven by our findings in Study #1, we use survey data in Study #2 to shed light on the prevalence of exposure to marijuana product reviews in general among current marijuana users residing across the U.S. in order to establish a baseline of this occurrence; we further examine exposure to these reviews and their associations with marijuana use behaviors. The research we present here is a timely contribution to the scientific literature and relevant for increasing understanding of the young adult marijuana users that view online product reviews and for scrutinizing the kinds of information and persuasive messages about marijuana that these types of videos are likely to entail.

Methods

Study 1: YouTube marijuana product reviews

Sampling and data collection—Two team members searched YouTube on June 10, 2015 to identify videos that consisted of marijuana-related product reviews using the search phrases “weed review”, “marijuana review”, and “cannabis review”. These search phrases were selected after viewing 10 top-ranked videos that resulted from YouTube “hits” using these search phrases, from which we determined that the content within these videos was appropriate for this study of user-generated online reviews about marijuana. We used the “relevance” sorting method, the default search method that displays videos that are most relevant to the search phrase as determined by YouTube’s internal algorithm; selecting

videos using the “relevance” sorting method has been used in other YouTube health-related research (Briones, Nan, Madden, & Waks, 2011; Vance, Howe, & Dellavalle, 2009). Using the relevance sorting method, the first 40 videos for each of the three search phrases (n=120) were recorded. Similar to other YouTube studies, the first 40 videos were chosen (Carroll, Shensa, & Primack, 2015; Forsyth & Malone, 2010; Freeman & Chapman, 2007; Primack, Colditz, Pang, & Jackson, 2015). After removing duplicate videos (n=17) and videos that were not product reviews (n=20), the final sample for analysis consisted of 83 videos.

General YouTube review characteristics—Research team members compiled descriptive characteristics of each of the videos provided by YouTube. Specifically, we recorded the video title, web address, view count, and video length. To inform viewers’ engagement with the videos, we documented the number of comments for each video. In addition to commenting on a video, a viewer may choose to click on an icon of the “thumbs up” sign to indicate that they “like” the video, or click on a “thumbs down” icon to indicate that they “dislike” the video. To supplement our original data collection from June 10, 2015, on March 1, 2016 we collected the number of “likes” and the number of “dislikes” for each video, and calculated the ratio of “likes” to “dislikes”.

We noted whether the video was restricted to adults only (i.e., age 18 years and above). YouTube places age restrictions on some videos with content that is not suitable for underage individuals (Google, 2015; YouTube, 2015b), but it is up to viewers to first flag a video as containing content that is not suitable for individuals under 18 years old. Then, YouTube staff reviews the flagged videos and places age restrictions on videos that are, in fact, inappropriate for younger viewers (YouTube, 2015c). We also collected information for each channel, or YouTube account that published the videos. This data included the channel name and total number of channel subscribers. We recorded whether the channel’s “About” page indicated that the account owner was a medical marijuana patient.

We classified the overall recommendation made by the reviewer about the marijuana-related product (i.e., sentiment of review) as favorable, negative, both positive and negative, or neutral towards the product being reviewed (i.e., whether or not the reviewer liked/endorsed the product being reviewed). We also coded for whether or not the reviewer within the video helped to facilitate a purchase of the product by providing information such as the store name, address, phone number, and/or store website. We further documented when the reviewer encouraged some type of follow-up social networking for viewers of these videos, including requests to “like” or “comment on” the video or to “subscribe” to the video creator’s channel. We also noted when the videos depicted someone consuming marijuana during the video.

Theme development and coding—To develop the codebook, three research team members viewed 20 of the 83 videos and discussed the content observed within the videos prior to coding. We noted any physical and/or mental health claims mentioned by the reviewer, guided by recent scientific findings regarding the recreational and medical reasons that marijuana users have cited for their marijuana use (Bonn-Miller, Babson, & Vandrey, 2014; Nunberg, Kilmer, Pacula, & Burgdorf, 2011; Osborn et al., 2015). We also coded the physical characteristics of the marijuana that were mentioned by the reviewer that had

potential for provoking viewers' senses, given that advertisers for other substances (e.g., tobacco and alcohol) have leveraged sensory marketing tactics (i.e., stimulating senses across sight, smell, and taste) to entice customers (Carpenter, Wayne, & Connolly, 2007; Fedoroff, Polivy, & Peter Herman, 2003; Mart, 2011; Mosher, 2011).

To analyze the videos, two student research interns watched and coded the videos together. A senior research team member separately viewed and coded each video. Inter-rater agreement across all codes ranged from moderate to almost perfect (median percent agreement 92 %, range 82% to 100%; median Cohen's kappa 0.70, range 0.50 to 1.00) (Landis & Koch, 1977). The themes with kappa values below 0.60 are noted in the footnotes of Table 2 and Figure 1. Any discrepancies were discussed among the team members and resolved.

Statistical analysis—Classifications and measures of the popularity and engagement of the videos were described using descriptive statistics. The number of views and comments, and ratio of “likes” to “dislikes” were described using the median rather than the mean because the distributions of these variables were positively skewed. Number of views and comments, and ratio of “likes” to “dislikes” were compared between videos that did and did not have an age restriction and between videos that included someone consuming marijuana versus videos that did not show consumption using negative binomial regression, with $p < 0.05$ considered statistically significant. SAS version 9.4 for Windows (SAS Institute Inc., Cary, NC) was used for analyses.

Study 2: Survey data on marijuana product reviews

We present results from an online survey of young adult (18–34 years old) current (past month) marijuana users conducted in July and August of 2015. The survey was conducted among members of SurveyMonkey® Audience, a proprietary online panel of participants drawn from the over 30 million people who take SurveyMonkey surveys. Weights were applied to the survey data so that marginal totals matched that of past-month marijuana users aged 18–34 years in the 2014 National Survey on Drug Use and Health (NSDUH) on age, gender and race. The SAS rake and trim macro was used to apply the weights using a raking technique (Abt Associates, n.d.). The weights were then normalized so that the sum of the weights equaled the sample size of our survey data ($N=742$).

Participants were asked how often they had SEEN or HEARD information about marijuana product or dispensary reviews or recommendations during the past 30 days. Similarly, participants were also asked how often they had LOOKED FOR or TRIED TO FIND information about marijuana product or dispensary reviews or recommendations during the past 30 days. Categorical responses were provided (e.g., not in the past 30 days, 1–2 times, 3–5 times, etc.). Participants were queried about demographic characteristics (e.g., gender, age, race, completed education level) and state of residence, which was used to indicate region of the country and legal status of marijuana in the participant's state. Marijuana use characteristics were also assessed, including reason for use (medical, recreational, both), type of product(s) used (plant/bud-based products such as joints, blunts or bowls, edibles and/or marijuana concentrates which involves heating concentrated forms of marijuana with

high levels of THC and inhaling the resulting vapors), number of sessions of marijuana use on a typical day when they used marijuana, and how often they are high for 6 or more hours.

Statistical analysis—Analysis of survey data was conducted with SAS for Windows version 9.4 (SAS Institute, Cary, NC) using survey procedures to apply the survey weights. For descriptive statistics, weighted sample size and percentages are reported. Logistic regression was used to assess bivariate associations between demographic and marijuana use characteristics with viewing or seeking marijuana product or dispensary reviews. Those variables significant in bivariate analysis were entered into a multivariable logistic regression model. Odds ratios and 95% confidence intervals are reported.

Results

Study 1: YouTube marijuana product review videos

Characteristics of the videos are presented in Table 1. Among the 83 marijuana product review videos, the median number of views was 29,072 (interquartile range [IQR] 12,702 to 57,267) and the total number of views across all videos was 5,107,923. Two videos disabled the comments function, but among the other 81 videos the median number of comments was 82 (IQR 33–125). Among all 83 videos, the median ratio of “likes” to “dislikes” was 13.2 (IQR 8.0–25.6). Only 13% (11/83) of the videos were restricted to viewers who were 18 years old.

Using negative binomial regression, we found that the number of comments was higher among videos that were age-restricted; the expected increase in log count of comments for videos that were age-restricted was 1.04 (SE 0.37, $p=0.006$). However, the ratio of “likes” to “dislikes” was lower among age-restricted videos; the expected change in log count of comments for age-restricted videos was -0.80 (SE 0.32, $p=0.012$). There was no significant difference in the number of views between videos with and without an age restriction. The 83 videos were published by 38 channels, with a median number of subscribers for the channels of 2,522 (IQR 443 to 57,238). Only 13% (5/38) of the channels indicated being a medical marijuana user.

A specific form of marijuana was reviewed in most videos (72/83, 87%) versus reviews of devices to consume marijuana or marijuana-related accessories (12/83, 13%). Of the videos about a specific form of marijuana, a plant-based marijuana product such as buds, joints, blunts, and clones were reviewed in 85% of the videos (61/72). Marijuana edibles were reviewed in 11% of the videos (8/72) and high-potency marijuana forms, also known as marijuana concentrates (i.e., shatter, wax, or oil) were similarly reviewed in 11% of the videos (8/72).

In terms of the observed behaviors from reviewers that could potentially influence marijuana use and/or purchasing decisions, the vast majority of the reviewers (93%; 77/83) delivered favorable opinions of the marijuana-related product being reviewed. To help facilitate a purchase of the product, approximately 61% (51/83) of the reviewers provided the information needed for a potential consumer to purchase the marijuana-related product, such as the store name, address, phone number, or website. A large majority (64/83, 77%) of the

reviewers encouraged some type of follow-up social networking for viewers of their video, including requests to “like” or “comment on” the video or to “subscribe” to the video creator’s channel. We additionally observed that nearly all of the videos (87%; 72/83) depicted someone consuming marijuana sometime during the video. Negative binomial regression revealed that videos that showed someone consuming marijuana had more comments than videos that did not depict consumption; the log count of comments for videos that portrayed someone using marijuana was 1.50 (SE 0.37, $p < 0.001$) higher than videos that did not show marijuana consumption. There were no significant differences in the number of views or ratio of “likes” to “dislikes” between videos that did and did not show marijuana consumption.

Content of the YouTube product reviews—Nearly half of the videos reported that the marijuana being reviewed within the video was successful for achieving the outcome of getting one to experience the feeling of being “very high/intoxicated” (44%; 32/72). Over one-third of these videos indicated that the marijuana product helped one to feel more relaxed (25/72, 35%) while 22% of the videos noted pain relief (16/72). Other personal experiences that were relayed about the marijuana product were that it was beneficial for sleep (15/72, 21%), that it improved emotional well-being (15/72, 21%), and that it would be energizing or would not result in sedating or drowsy effects (19%; 14/72). Table 2 provides example quotes from the videos.

Reviewers tended to discuss qualities of the marijuana-related product(s) being reviewed which could stimulate viewers’ senses. Specifically, most of the reviewers within the videos described details about the marijuana’s appearance/color (59/72, 82%) and flavor/taste (58/72, 81%). Over half of the reviewers within the videos also discussed the smell/aroma of the marijuana (45/72, 63%). Slightly over one-quarter of the reviewers indicated that the marijuana provided a “smooth hit” (19/72, 26%). Figure 1 provides example quotes from the videos.

Study 2: Survey results

Demographic characteristics of respondents—Detailed characteristics of our survey respondents can be found in Table 3. Among the 742 current marijuana users who responded to our survey, 62% (460/742) were male, 63% (468/742) were white, and the range in age was 18 to 34 years, with a median of 23 and mean of 24.8 (SE 0.21). Approximately 75% (558/742) had at least some college education. Regarding region of residence, 31% (228/726) lived in the Western U.S., 28% (202/726) lived in the South, 20% (149/726) in the Northeast and 20% (148/726) in the Midwest. Twelve percent (87/726) lived in a state where recreational marijuana use was legal and 49% (354/726) in a state where medical marijuana use was legal. Approximately 57% (424/742) used marijuana for only recreational reasons, while 15% (111/742) used for only medical reasons and 28% (207/742) used for both medical and recreational reasons.

Exposure to marijuana reviews—Approximately 1/3 (34%) of the current marijuana users either viewed or sought a marijuana product or dispensary review in the past 30 days. Table 3 (bottom row) shows more detailed responses about the frequency of viewing or

seeking such reviews. Significant bivariate associations between viewing/seeking reviews and demographic and marijuana use characteristics are shown in Table 4. Those who were of a race other than White (odds ratio [OR] 1.6, 95% confidence interval [CI] 1.1 to 2.5) or lived in a state where recreational use was legal (OR 2.5, 95% CI 1.4 to 4.3) were significantly more likely to view or seek reviews in bivariate analyses. Those with some college education were less likely than those with a high school education or less to view or seek reviews (OR 0.5, 95% CI 0.3 to 0.9). Also in bivariate analyses, viewing or seeking marijuana reviews was more common among poly-marijuana users (i.e. used multiple forms of marijuana in the past month) (OR 3.4, 95% CI 2.3 to 5.1), those who used marijuana more than once a day on the days they used, (OR 2.3, 95% CI 1.5 to 3.3) or who were “high” for 6 or more hours at least once a month (OR 2.0, 95% CI 1.4 to 3.0). Compared to those who used for medical reasons only, those who used marijuana for only recreational reasons were less likely to view or seek reviews (OR 0.3, 95% CI 0.2 to 0.6).

In the multivariable logistic regression model (Table 4), those living in states where recreational use is legal (adjusted odds ratio [aOR] 2.4, 95% CI 1.2 to 4.9) and poly-marijuana users (aOR 2.7, 95% CI 1.8 to 4.2) had significantly greater odds of viewing or seeking marijuana reviews than those living in states where use is not legal or those who used only one form of marijuana. Those with some college education (aOR 0.5, 95% CI 0.3 to 0.8) or used marijuana solely for recreational reasons (aOR 0.5, 95% CI 0.3 to 0.9) had decreased odds of viewing/seeking reviews compared to those with a high school education or less or those who used solely for medical reasons.

Discussion

This study investigated product reviews about marijuana by way of a content analysis of product review videos displayed on YouTube. To place these types of product review videos in context of YouTube viewership, they had higher view counts (median near 30,000) than most general YouTube videos (an average of up to only 10,000 views irrespective of their category) (Marshall, 2015) less views than videos about cigarettes (median >600,000 views), e-cigarettes and alcohol (median >130,000 views for both products) (Carroll et al., 2015; Romito, Hurwich, & Eckert, 2015), but comparable with views about marijuana concentrates (median ~30,000 views) (Krauss et al., 2015a; Huang et al., 2016). Given the popularity of these YouTube videos, we further utilized survey data to study the prevalence of broader exposure to marijuana product reviews in general among current marijuana users across the U.S. With about one-third of our sample of young adult marijuana users either viewing or seeking out product reviews at least one time in the past month, our findings are the first known of its kind to quantify exposure to product reviews about marijuana and provide a baseline for future studies in this area.

In terms of their content, the marijuana product review videos analyzed in this study contained, for the most part, favorable discussions about marijuana where reviewers consumed the marijuana product during the video and shared personal experiences and/or described attributes about the marijuana being ingested. A troublesome finding of our study was that numerous reviewers reported getting “very high/intoxicated” following marijuana use and touted an intensified feeling of intoxication (i.e., getting as high as possible) as the

most desired effect that one could get following the marijuana use. In contrast, we did not observe warning messages that would educate viewers about the possible acute effects following marijuana use that could be problematic, including such experiences as impaired cognition, rapid heartbeat, blackouts, paranoia and/or hallucinations following marijuana use (Hall & Degenhardt, 2009; John, 2015; Stogner & Miller, 2015). Our findings signal a public health need to balance the pro-marijuana messages delivered in review videos about marijuana with prevention messages about the known risks of marijuana use so that viewers of these online videos are fully informed of all possible consequences that may follow use; these prevention messages may be especially critical for young adults who tend to have the greatest prevalence of marijuana use versus other age groups and are at risk for transitioning their experimental drug use behaviors to a stage of regular use (Marlatt, 2006; Moss, Chen, & Yi, 2014; van der Pol et al., 2013).

With regards to the additional kinds of persuasive messages about marijuana that we observed within videos, reviewers often described healing attributes following marijuana use. For instance, positive marijuana effects on physical and mental health were often explicitly reported by individuals within the videos via descriptions of improved relaxation, sleep, mood, and/or relief of pain that subsequently followed marijuana consumption. While not supported by our data, it is reasonable to speculate that without counterbalance, viewers' exposure to these marijuana promotions could shift perspectives towards increased normalization of its use, in general, and especially for the "healing" and "medicinal" purposes that the reviewers themselves claimed to experience. Likewise, the normalization framework has utility for explaining how attitudes that view marijuana use as a deviant drug use behavior can shift towards acceptability and accommodation within increased exposure to this viewpoint (Measham & Shiner, 2009).

Our multivariable model indicates that individuals who use marijuana solely for medical reasons have a higher likelihood of being exposed to product reviews about marijuana. Given that product reviews are often utilized by potential consumers who tend to be information-seeking, our findings may indicate an unmet need for additional information about marijuana that is greater among those who use it for medical reasons. As well, marijuana users who are less educated have a higher likelihood of being exposed to product reviews about marijuana versus counterparts. This is concerning because the pro-marijuana content observed within the videos in this study corroborates our existing social media studies on this topic that collectively reveal pervasive online messages promoting marijuana use behaviors (Cavazos-Rehg et al., 2015; Cavazos-Rehg et al., 2016; Krauss et al., 2015a; Krauss et al., 2015b). Lower education, poverty and poor health are highly correlated outcomes that can be exacerbated with substance misuse behaviors (Redonnet et al., 2012; Silins et al., 2014). Because our findings indicate that product review videos are disproportionately observed by individuals with lower education, future studies should disentangle the extent to which observing online pro-marijuana messages are one pathway to problematic marijuana use behaviors and subsequent, related negative outcomes.

There is emerging research that indicates individuals who use multiple forms of marijuana tend to be heavier users of marijuana versus individuals who solely use one form of marijuana (Oregon Public Health Division, 2016). Related, our regression model shows

significantly positive associations between increased exposure to product reviews about marijuana and poly-marijuana use. Novel forms of marijuana products are emerging (i.e., concentrates and edibles) and increasing in use (Marijuana Business Daily, 2016), and it is therefore possible that individuals who consume more than one form of marijuana turn to product reviews about marijuana because they have interest in and are curious about ingesting marijuana in non-traditional forms. It will therefore be important for future studies to further examine why individuals with potentially problematic marijuana behaviors are more likely to be exposed to product review videos.

There are some limitations of the study worth noting. For Study 1, we used existing research to guide our methods on the sample size of relevant videos to assess (Carroll et al., 2015; Forsyth & Malone, 2010; Freeman & Chapman, 2007; Primack et al., 2015), and a larger study could reveal themes that were not accounted for in our study. In addition, our search terms were carefully selected in order to hone in on user-generated online reviews about marijuana; other search terms could yield different results. Our findings may be biased by individuals on YouTube who are marijuana users and are more likely to socially networking about marijuana and/or write positive reviews about the videos under study. In Study 2 we relied on self-report cross-sectional survey data which is subject to recall bias and does not allow the identification of causal associations. The survey was not nationally representative, but we did weight participants to match the distribution of marijuana users on age, sex, and race based on a large national survey. Finally, Study 1 was focused on YouTube videos and our survey data in Study 2 asked about marijuana product or dispensary reviews broadly and not specifically on YouTube; continued research that studies this content on multiple platforms beyond YouTube and/or more directly investigates exposure to product review videos could enhance the findings of our study.

Despite this, our study importantly delineates socio-demographic and marijuana use characteristics of young adult marijuana users who have increased exposure to product reviews about marijuana. We found that user-generated marijuana-related reviews are prevalent and popular on YouTube. This is troublesome because most of the videos that we investigated could be readily accessed and viewed by underage individuals. Additionally, our survey data indicates significant associations between exposure to product reviews about marijuana and individuals who have a lower education versus more educated counterparts. Because we did not observe that pro-marijuana messages within videos were offset with content about the potential harms associated with use, prevention efforts should work to counterbalance these videos. Compliance with Ethical Standards

Acknowledgments

Funding: This study was funded by the National Institutes of Health [R01DA032843, R01DA039455] and the Washington University Institute of Clinical and Translational Sciences grant [UL1 TR000448] from the National Center for Advancing Translational Sciences (NCATS).

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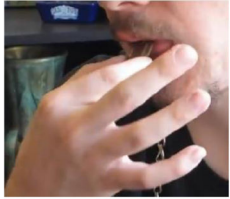
Themes	n (%)	Example quotes	
Color/appearance ^a	59 (82%)	 <p><i>"Some beautiful concentrate here, real clear, stable. I mean it's a pretty firm pull and snap, it comes off the paper and you can see the clarity on it."</i></p>	 <p><i>"It looked like they took these buds and drove them through a mound of sugar and you know, that's what was left on the buds... It's very blessed. It looks very nice."</i></p>
Flavor/taste	58 (81%)	 <p><i>"Tastes very earthy. You can feel the richness and flavor when you hit it. Tastes weed-tastic!"</i></p>	 <p><i>"You instantly taste the coconut. Right off the bat. Smooth, coconut and chocolate. It's like an Almond Joy."</i></p>
Aroma	45 (63%)	<p><i>"Just opening the bag and giving it a whiff, holy shit, oh man it just smells like a bag of blueberry muffins or just like candy. It is just mouthwatering."</i></p>	<p><i>"It's a really strong, rich tone – almost piney... like a pine cone from a tree... it's really strong. I really like it. It's not skunky or diesel-y smell, it's like a flowery tree, rich, strong, green aroma"</i></p>
Smooth hit ^a	19 (26%)	<p><i>"Very smooth. I'm holding it in, it's very smooth. Oh I can taste the licorice already!"</i></p>	<p><i>"Really smooth on the inhale and exhale. Felt it expanding a little bit in my lungs, but nothing that was harsh about it at all."</i></p>

Figure 1.

Product details in videos where a form of marijuana was reviewed (N = 72)

^aThemes with kappa <0.60 (Color/appearance 0.53; Smooth hit 0.56)

Table 1

General characteristics

Videos (N=83)		
Number of views	median (IQR)	29,072 (12,702 to 57,267)
Total number of views across all videos	median (IQR)	5,107,923
Video length (minutes)	median (IQR)	6.7 (4.1 to 10.8)
Number of comments ^a	median (IQR)	82 (33 to 125)
Number of “likes”	median (IQR)	215 (87 to 420)
Number of “dislikes”	median (IQR)	15 (7–27)
Ratio of “likes” to “dislikes”	median (IQR)	13.2 (8.0 to 25.6)
Age restricted	n (%)	11/83 (13%)
Channels (N=38)		
Number of subscribers	median (IQR)	2,522 (443 to 57,238)
Total number of subscribers across all channels		3,293,689
Indicated medical marijuana	n (%)	5/38 (13%)
Reviewer behavior (N=83)		
Sentiment of the review	n (%)	
Positive	n (%)	77 (93%)
Negative	n (%)	4 (5%)
Both	n (%)	1 (1%)
Neutral	n (%)	1 (1%)
Consumed marijuana within the video	n (%)	72 (87%)
Encouraged social networking	n (%)	64 (83%)
Provided store information to facilitate purchase	n (%)	51 (61%)

Table 2

Benefits/health claims of marijuana in videos where a form of marijuana was reviewed (N = 72)

Benefits/Health claims	n (%)	Example quotes
Gets user very high/intoxicated	32 (44%)	• "I feel pretty high right now. My head is ready to go. I feel relaxed. I feel happy. I feel calm and most of all I'm really really high!"
		• "I'm super stoned right now. We just smoked. I hit the [bong] and it was awesome! Definitely gonna smoke more of this, but just so you know, this is a really good strain. I'm super stoned and I smoke every day."
Facilitates relaxation	25 (35%)	• "I'm feeling mellow after smoking that joint. A little tingly, kind of sleepy."
		• "I'm relaxed. I'm spaced out, but not in like an annoying way, in a relaxing way and I'm so calm and comfortable..."
Pain relief	16 (22%)	• "I guess I could say it does give you an interesting feeling, but it's more of a pain-killer property type thing."
		• "I can feel it ease the tension in my head almost immediately. It's really good for pain. I would recommend it for any regular smoker who needs to smoke to ease their pain throughout the day, but doesn't want to fall asleep."
Aids with sleep ^a	15 (21%)	• "One hit wonder, like I said, puts you right to bed."
		• "They said this strain is also good for insomnia and I can see that because I'm so relaxed that if it was dark out or if it was nighttime, I could definitely fall asleep right now."
Improves emotional well-being	15 (21%)	• "It's a good high... I actually feel good. I feel happy." "It gives a great clear, happy head high that works for daytime, for nausea, depression, bi-polar disorder and a multitude of other illnesses."

^aThemes with kappa <0.60 (Aids with sleep 0.58; Improves emotional well-being 0.50)

Table 3

Characteristics of survey participants (N=742 unless otherwise noted)

Variable	Weighted n (column %)
<i>Demographic and marijuana use characteristics</i>	
Gender	
Male	460 (62)
Female	282 (38)
Age (years) median (range)	23 (18 to 34)
Race	
White	468 (63)
Black	116 (16)
Hispanic	109 (15)
Other	49 (7)
Education	
High school	184 (25)
Some college	326 (44)
Bachelor's degree	232 (31)
U.S. Census region (n=726)	
Northeast	149 (20)
Midwest	148 (20)
South	202 (28)
West	228 (31)
Legal status of marijuana in state (n=726)	
Both recreational and medical	87 (12)
Only medical use	354 (49)
Use is not legal	285 (39)
Reason(s) for using marijuana	
Recreational reasons only	424 (57)
Medical reasons only	111 (15)
Both medical and recreational	207 (28)
<i>Exposure to marijuana product or dispensary reviews or recommendations</i>	
Saw or heard reviews/recommendations in the past 30 days (n=732)	
Not in the past 30 days	530 (72)
1–2 times	118 (16)
3–5 times	51 (7)
>5 times	33 (5)
Looked for or tried to find reviews/recommendations in the past 30 days (n=739)	
Not in the past 30 days	595 (80)
1–2 times	96 (13)
3–5 times	28 (4)
>5 times	20 (3)

Table 4
Associations between participant characteristics and viewing/seeking marijuana product reviews ^a

Participant characteristic	Did not view or seek reviews/ recommendations Weighted n (row %)	Viewed or sought reviews/ recommendations Weighted n (row %)	Bivariate association OR (95% CI)	Multivariable model ^b aOR (95% CI)
Race				
White	328 (71)	137 (29)	Ref.	Ref.
Other	161 (59)	110 (41)	1.64 (1.07, 2.50)	1.54 (0.96, 2.47)
Education				
high school	106 (58)	78 (42)	Ref.	Ref.
Some college	230 (71)	92 (29)	0.55 (0.33, 0.91)	0.52 (0.29, 0.92)
Bachelor's degree	153 (67)	76 (33)	0.67 (0.41, 1.11)	0.71 (0.39, 1.27)
Legal status of marijuana				
Not legal	196 (69)	86 (31)	Ref.	Ref.
Medical use is legal	239 (68)	113 (32)	1.07 (0.69, 1.68)	1.16 (0.73, 1.86)
Recreational use is legal	42 (48)	45 (52)	2.45 (1.39, 4.31)	2.41 (1.19, 4.88)
Reason for using marijuana				
Medical	54 (49)	57 (51)	Ref.	Ref.
Recreational	313 (75)	105 (25)	0.32 (0.19, 0.55)	0.52 (0.29, 0.92)
Both	122 (59)	84 (41)	0.65 (0.36, 1.19)	0.79 (0.41, 1.52)
Poly-marijuana use				
Yes	144 (49)	147 (51)	3.40 (2.25, 5.12)	2.72 (1.77, 4.19)
No	314 (77)	95 (23)	Ref.	Ref.
On typical day when use marijuana, use 2 times/day				
Yes	234 (59)	166 (41)	2.25 (1.52, 3.33)	1.37 (0.85, 2.19)
No	255 (76)	80 (24)	Ref.	Ref.
High for 6 more hours at least once per month				
Yes	223 (59)	154 (41)	2.02 (1.36, 2.99)	1.26 (0.80, 1.99)
No	266 (75)	91 (25)	Ref.	Ref.

^aThere were no significant associations between viewing/seeking marijuana product reviews and gender and age.

^bMultivariable model includes all variables listed in this table.