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Prevalence of Marijuana-Related Traffic on Twitter, 2012–2013: A Content Analysis

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Abstract

This study assessed marijuana-related content posted by adolescents on Twitter and examined content variation before and after the 2012 U.S. election legalizing recreational use in two states. For two 3-week periods occurring 6 months before and after the election, a 1% random sample was obtained of all tweets matching a set of marijuana-related queries. Original content was separated from reposted content (retweets), and foreign language tweets and those not related to marijuana were excluded. Using a structured codebook, tweet content was categorized (e.g., mention of personal marijuana use, parents' views, perceived effects.) Self-reported age was extracted from tweet metadata when available. Chi-square tests were used to assess differences in content by whether the user self-identified as an adolescent and to compare content pre- versus post-election. The full sample consisted of 71,901 tweets. After excluding nonrelevant tweets and separating original tweets from retweets, the analytic sample included 36,969 original tweets. A majority (65.6%) of original tweets by adolescents ($n = 1{,}928$) reflected a positive attitude toward marijuana, and 42.9% indicated personal use. Of adolescents' tweets that mentioned parents, 36.0% of tweets indicated parental support for the adolescent's marijuana use. Tweets about personal marijuana use increased from 2012 to 2013, as did positive perceptions about the drug. Adolescents and others on Twitter are exposed to positive discussion normalizing use. Over the study period, Twitter was increasingly used to disclose marijuana use.

Introduction

Marijuana use has increased in the last decade, with an 8% rise from 2011 to 2013.[1] In the United States, more young adults use marijuana than any other illicit drug, with 52% reporting use within their lifetime.[2] This is particularly concerning because studies indicate that tetrahydrocannabinol (THC), a major psychoactive compound in marijuana, is associated with multiple adverse effects, including lasting memory impairment, increased anxiety,[3,4] cognitive deficits and brain changes,[5] attention dysfunction,[6] impaired visual scanning,[7] reduced overall or verbal IQ,[8,9] and impaired executive functioning.[10,11]

Despite research indicating negative impacts of marijuana, particularly for adolescents, attitudes toward the drug are becoming increasingly permissive in the United States.[12] In the November 2012 general election, Washington and Colorado legalized recreational cannabis use for adults. In 2014, Alaska and Oregon passed similar legislation. At the state level, there is substantial variation in marijuana policy, ranging from legal recreational and medical use in Washington, Colorado, Alaska, and Oregon to criminalized possession in 23 states.[13] Public opinion polls suggest that the majority of Americans support legalization of recreational marijuana use, regardless of the laws in their home state.[14] The attitude of adolescents toward marijuana has also become more positive in recent years. Adolescents are increasingly discounting the risks of marijuana and showing less disapproval of marijuana use by their contemporaries.[15] Given that perceived norms have been shown to significantly impact adolescent alcohol and other drug (AOD) use, it is important to analyze the marijuana-related content being disseminated within peer networks.[16]

The Internet is one venue where adolescents express and observe social norms. Social networking sites in particular provide exposure to content from peers, whose mention of a substance is a strong predictor of alcohol and drug use.[17–21] As of 2013, approximately 81% of 12–17 years olds use

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social networking sites.[22] Several studies have found that adolescents who interact in social networks with a greater quantity of AOD content are more likely to use alcohol than those whose peer networks have less AOD content.[19,23–25] Peer networks also appear to affect adolescent marijuana use, though the mechanisms of this relationship remain controversial. Studies examining the impact of offline peer influence have generally found that peer use predicts changes in self-use, and that individuals are more likely to select friends who share their substance use patterns.[19,26–28] Less is known about the connection between social media communities and marijuana use. A 2012 study found no correlation between AOD content on social media Web sites and marijuana use, noting only a negative relationship between the perception that posting marijuana-related content could have detrimental effects and use of the drug.[29] A more recent study found that substance use was associated with perceived prevalence and perceived support of use by the members of online networks.[19] A possible explanation for the discrepancy between these studies is the difference in the legal status of marijuana at the time the research was conducted. The 2012 study finding no correlation between marijuana use and AOD content on social media websites used data collected prior to recreational legalization. It has been suggested previously that the legality of a substance or its perceived social stigma may influence willingness to communicate about usage behavior via social media.[19,27,28,30] Given that attitudes and laws regarding marijuana are changing nationally, the relationship between social media and drug use merits further investigation. Furthermore, social media use itself remains dynamic. Usage may vary based on the types of communication and peer networks engendered by a given application.

Neither of the previous studies investigating the connection between social media communities and marijuana did so within the context of Twitter.[19,29] Twitter differs considerably from other social media networks such as Facebook in that it offers users greater anonymity, and thus greater opportunities for self-expression without concerns for reputation.[22] Perhaps due to its anonymity, Twitter often functions as a platform for adolescents to exchange information about illicit substances and display risk behaviors, as shown in previous studies regarding prescription drug abuse.[31,32] Individuals who discuss their own drug abuse on Twitter are more likely to belong to social media circles with other Twitter users who also discuss abusing drugs.[31]

Adolescents' use of Twitter is on the rise: 24% of online youth aged 12–18 years reported using the network in 2013, as compared to 16% in 2011.[22] Given the youthful demographic of Twitter and the increasing number of adolescents using it, understanding the discussion about marijuana on the network is important, as it represents a source of exposure to information about the drug and may contribute to perceived norms.[33]

Previous studies have demonstrated that Twitter is a useful tool for identifying emerging health trends,[31,32,34,35] but only one study has looked at the marijuana-related material on Twitter. Cavazos-Rehg et al. recently conducted a pilot study that examined the followers and content associated with one popular pro-marijuana Twitter handle, ''@stillblazingtho.'' They found that roughly 82% of the tweets associated with the account expressed positive sentiments regarding marijuana.[36] Using specialized software to infer ages, Cavazos-Rehg et al. determined that 73% of the followers of the account were younger than 20 years of age.[36] This age distribution is lower than the median age distribution on Twitter, suggesting that younger users may be particularly vulnerable to marijuana-related content on Twitter that normalizes use.[36] This pilot study, which examined only the tweets associated with one pro-marijuana account, highlights the need for a broader investigation of marijuana-related traffic on Twitter. To the authors' knowledge, this is the first large-scale study exploring these themes.

The purpose of the present study was to examine marijuana-related content in Twitter, especially that tweeted by adolescent users, and to examine any differences in marijuana-related message content before and after two states legalized recreational marijuana. The goal was to understand better the types of messages about marijuana that adolescents potentially observe and send on Twitter, and how the prevalence and content of these messages may vary as the sociopolitical attitudes toward the drug shift with increasing legalization.

Methods

Data collection

To capture the breadth of tweets about marijuana a set of marijuana-related keywords were defined. Several common terms (''marijuana,'', ''pot,'' and ''weed'') were entered into the search engine of six networks identified by Pew Research in May 2013 as the most popular among teens: Facebook, Twitter, Instagram, MySpace, YouTube, and Tumblr.[22] Auxiliary terms associated with these first three words were noted if they related to marijuana and were mentioned at least five times within the context of the Web site. These auxiliary terms were then entered as a new search item into the six sites to discover additional terms related to marijuana use, subject to the same prevalence restrictions. Keywords continued to be generated through this cyclical process until no novel terms appeared.

Next, to identify more obscure slang, Google and Urban Dictionary were used. Using ''marijuana slang list'' as the search entry, every corresponding entry was examined on Google until the entries on a given search page became $< 30\%$ relevant. On Urban Dictionary, the word ''marijuana'' was entered into the search engine and then the related words function on the site was used. Each related word was entered into the site's search to generate additional words related to marijuana use, until no novel terms appeared. Each of the terms generated from Google and Urban Dictionary were then entered into the six social media sites to see if they were used more than five times. If this was the case, they were added to the list of potential keywords. From an initial list of approximately 40 terms, the keyword list was shortened further by entering each term into Twitter once more. Search terms were excluded or modified that returned a batch of tweets in which more than 30% of the tweets were unrelated to marijuana use, resulting in a final set of seven queries: ''weed,'' ''marijuana,'' ''cannabis,'' ''smoke AND (pot OR joint OR blunt OR mary jane),'' ''need AND (pot OR joint OR blunt),'' ''want AND (pot OR a blunt),'' and ''want AND a joint.''

In cases where two search terms were combined (e.g., need AND (pot OR joint OR blunt)), the terms needed to be within three words of each other for the tweet to qualify for analysis. This method of generating keywords aligns with previous work generating keywords for studies related to

Twitter. Previous studies have generally identified key terms either via expert consensus or through analysis of tweets or Internet content related to a primary term of interest.[37–41]

Next two time periods for the study were defined that would allow the content of tweets posted before and after the November 2012 election to be compared. To mitigate the possibility of an inflated number of marijuana-related tweets due to conversations about the marijuana-related ballot items, the 6 months immediately before and the 6 months immediately after the election were avoided. The second weeks in March, April, and May of 2012 were selected as the pre-election period, and the second weeks in May, June, and July of 2013 were selected as the post-election period.

A select number of companies have access to all publically available tweets posted since Twitter's launch in March 2006.[42] The text analytics software company DiscoverText provided the number of publicly available tweets that matched our marijuana-related queries during the specified time periods ($N = 7{,}290{,}100$). A 1% random sample of these tweets was obtained from DiscoverText.

In addition to the text of each tweet, the data file contained metadata for each tweet, including the sender's username and the date and timestamp indicating when the tweet was sent. Access was also available to the user-generated profile biography that Twitter users include in their public account profiles. All information was publicly available, and this study was judged exempt by the Institutional Review Board at the University of Washington.

Analysis

The sample was separated into two groups: original tweets and retweets. Retweets occur when one Twitter user reposts the content of another user's tweet, adding the capital letters ''RT'' immediately prior to the content. Studies estimate that approximately 24% of all tweets are retweets.[43] Ideas expressed in an original tweet can be attributed to the sender, but the sender's view on the content of a retweet may be unclear. Therefore, original tweets were prioritized in the analysis, examining all original tweets in the main sample, and a random subsample of 10,000 retweets. Analysis involved extracting demographic information through automated coding of metadata, manually coding the content of each tweet, and calculating descriptive statistics.

The sample included 41,225 original tweets and 30,676 retweets. The research team examined and manually coded all the original tweets, excluding 2,131 (5%) from further analysis because they contained non-English content and excluding 2,101 (5%) because they were clearly not relevant to marijuana as indicated by descriptive content indicating an alternate context (e.g., ''working and my weed whacker broke'' #workprobz). Tweets with ambiguous context or no context (e.g., ''weed weed weed'') were included. This resulted in a final sample of 36,939 original tweets. Of the 30,676 retweets, a random subsample of 10,000 tweets was examined, excluding 553 (6%) because they contained non-English content and 352 (4%) because they were not relevant to marijuana.

Automated coding

Automated coding involved using simple text match formulas to extract information on the age of the person sending the tweet. To identify tweets sent by adolescents, a search was made for a reported age matching any number between 11 and 22 (e.g., 14), spelled out numbers in this age range (e.g., fourteen), and words that suggested membership in this age group (e.g., middle school, high school, college). Each user's biography was searched for this information. A binary variable was coded to indicate whether a tweet was posted by a self-identified adolescent or if age was unknown. Of 36,939 original tweets included in the analysis, 1,928 tweets (5%) contained information in the profile biography indicating that the user was an adolescent. To verify the age determining method, a random 10% sample of the tweets that the automated system identified as being from an adolescent were manually checked by viewing the participants profile information and confirming the presence of information indicating an age between 11 and 22 years (see examples above). This process revealed that the automated coding had 93% accuracy.

Manual coding

An iterative, empirical, data-driven method was used to categorize the content of tweets, developing a codebook by reviewing a sample of approximately 1,000 tweets for common themes in the text (Table 1). This codebook was applied, manually examining each tweet for relevance, excluding nonrelevant tweets and tweets containing any words in languages other than English. With the remaining tweets, first the subject of the tweet was coded to identify who it was about (self, other, general, or subject unclear). Codes were then applied to capture the tone of the tweet with respect to marijuana (positive or negative), whether the tweet was about using the drug. Finally, related behaviors, perceived impacts, and/or social context were coded. These categories had emerged as significant during the initial codebook development. Table 1 contains an abbreviated version of the codebook with definitions and examples for the more ambiguous codes. Code categories under the headings of ''Subject,'' ''Use Category,'' and ''Tone'' were mutually exclusive. Multiple codes under other headings could be coded. Codes are presented in Tables 2–4.

Two authors (L.T. and J.W.) with research experience in the areas of social media and substance use independently applied the draft codebook to a random sample of 100 tweets to check interrater reliability. It was found that the coding corresponded 84% of the time. Discrepancies were discussed, and the codebook was further refined and then applied to an additional 100 tweets, resulting in a final Cohen's kappa of 94%. One author (L.T.) then proceeded to code the remaining tweets.

Statistical analysis

Descriptive statistics including chi-square tests were used to assess differences in original tweet content by whether the user reported being an adolescent and pre- versus post-election. It was then examined whether retweets are different from the original tweets on these factors. Because of the large sample size, the alpha level for statistical significance was set at $p < 0.01$.

Results

Tweets from adolescents and persons of unknown age

The main differences, shown in Table 2, between tweets from adolescents and those of unknown age were that

Table 1. Abridged Codebook with Key Examples

Code	*Definition*	*Includes*	*Excludes*
Subject[a]			
Self	First person subject	We, ''Madonna and I''	They, he, Snoop Dog
Other	Specific person is the subject	Obama, @joeshmoe	''People''
General	Unspecified people are the subject; includes personal opinions w/ an implied subject	''Everyone should smoke weed''	''Good weed''
Unclear subject	Subject is unclear	''99 bottles of weed''	''Weed kills''
Tone[b]			
Positive	Explicitly positive attitude	''Weed smoker 4 lyfe''	''I love weed but I'm trying to quit''
Negative	Explicitly negative attitude	''Weed kills''	''I hate when girls slobber on the blunt''
Unclear	Tone of tweet is ambiguous	''My timeline has so many weed smokers in it''	''I don't smoke weed b/c it's cool, I do it to get high''
Use category[c]	Shows documented use/possession of weed in a specific time frame (past, present, future)	''Want to smoke with me after school?''	''People need to smoke more''
Related behaviors			
Refers to habitual use	Time frames within the tweet indicate that the subject's marijuana is habitual	''I haven't smoked my daily blunt''	''I smoke a lot,'' ''I'm a pothead''
Notes social aspect of use	Marijuana use as a social interaction (desired or actual) involving the subject	''I need someone to smoke this joint w/ me''	''weed makes me more friendly''
Can't/doesn't smoke	Subject cannot smoke because of circumstances or doesn't smoke	''Can't smoke b/c my job does drug testing''	''I can't smoke…alone''
Positive aspects mentioned			
Sees marijuana use as a social norm	Subject views marijuana use as the social norm: indicated by references to parents condoning its use/using, or by statements that reveal perceptions that ''everyone'' is using	''Only people who haven't tried weed are against it,'' ''My dad and I just smoked together''	''My parents don't like that I smoke,'' ''My friends and I smoke a lot of weed''
	Subject believes that weed is not a drug, or that weed is not harmful, or that marijuana use has no negative impacts	''Weed is a plant not a drug, embrace it''	''Weed makes me happy''

[a]Refers to subject attached to marijuana-related verb within a tweet.
[b]All tone designations refer to the attitude of the tweet regarding marijuana.
[c]This code was divided into subject subcategories: refers to own use and refers to use by others.

adolescents were about half as likely to discuss news of marijuana legalization than people of unknown age ($p < 0.001$). In addition, adolescent tweets were more likely to reference a parent or mention an inability to smoke marijuana, either by preference or due to environmental circumstances, for example. ''can't smoke weed b/c my soccer team is getting drug tested tomorrow #blows'' ($p = 0.002$).

Focusing on the subgroup of 1,928 tweets from age-disclosing adolescents, nearly two-thirds (66%) of these tweets mentioned marijuana in a positive tone, while only approximately 7% had a negative tone (Table 2). Of the tweets written by this age group, 43% disclosed personal use of the drug. There was evidence of concurrent use of alcohol (5%) and other drugs (3%). A small proportion of adolescent tweets referenced co-occurring risk behaviors, including having sex while high (1%) or driving while high (< 1%). Of the 50 tweets that contained a reference to a parent, 36% indicated parental support for their adolescent's marijuana use. Approximately 10% of tweets noted a perceived benefit of the drug, and 2% of tweets described marijuana use as normative. Less than 1% of tweets by adolescents mentioned trying to quit or described marijuana as more harmful than another substance. There were no mentions of marijuana as a gateway drug, no expressed desires to make marijuana laws more stringent, and no concerns about adolescent marijuana use as voiced by adolescents. Because these proportions were not significantly different from those of the overall sample, the much larger overall sample was used to examine marijuana references in tweets posted before and after the election.

Tweets in 2012 compared to 2013

There were small but statistically significant differences in documentation of use and in discussion of marijuana before compared with after the 2012 U.S. general election (Table 3). After the election, there was increased mention of general, habitual, and social marijuana use, and an increase in comments about the use of other drugs while high on marijuana. The number of tweets disclosing personal marijuana use also increased from about 40% to 43% ($p < 0.001$). Tweets posted after the election revealed a small, although statistically significant, shift in attitudes toward the drug (Table 3). In

Table 2. Content of Tweets by Self-Disclosed Adolescents Versus Age Unknown

Code	*Self-disclosed adolescents (n = 1,928) %*	*Age unknown (n = 35,011) %*	p *Value*
Subject			
Self	**54.88**	**51.67**	**0.006**
Other person	22.25	23.28	0.30
General	20.59	22.01	0.15
Unclear subject	2.28	3.05	0.06
Tone			
Positive	65.56	68.22	0.02
Negative	**7.00**	**5.08**	**<0.001**
Unclear	27.44	26.70	0.48
Legality			
Wants more lenient marijuana laws	**1.82**	**5.86**	**<0.001**
Use category			
Refers to own use	42.89	41.43	0.35
Refers to use by others	11.83	11.63	0.35
Doesn't refer to use	45.28	46.99	0.35
Related behaviors			
Refers to habitual use	0.57	1.03	0.05
Notes social aspect of use	3.94	3.84	0.81
Sex while high	1.24	1.28	0.90
Co-occurring alcohol use	4.62	4.05	0.22
Co-occurring drug use	2.75	2.43	0.37
Trying to sell marijuana or identifies self as dealer	0.78	1.09	0.20
Can't/doesn't smoke	**3.37**	**1.87**	**<0.001**
Positive aspects mentioned			
Marijuana use is a social norm	2.13	1.91	0.49
Marijuana better/less harmful than another drug	1.35	1.38	0.92
Marijuana not a drug, has no negative impacts	3.22	2.55	0.08
Marijuana causes relaxation, sleepiness	2.54	2.09	0.18
Marijuana use to escape/not care about problems	1.19	1.06	0.57
Marijuana use has other medical benefits	5.34	5.12	0.66
Other			
Parent referenced	**2.59**	**1.67**	**0.002**
Medical marijuana referenced	1.04	1.53	0.08
Pop culture reference or song lyric	14.99	15.50	0.55
News article	**2.28**	**3.87**	**<0.001**

Note: Bolded content denotes a *p*-value below the threshold of statistical significance ($p < 0.01$).

2013, more tweets described perceived positive benefits of marijuana use than in 2012, including relaxation/sleepiness and escaping life problems. Increasingly, tweets characterized marijuana as less harmful than other drugs or as not harmful at all, and posited a medical role for the drug in the treatment of ailments such as depression and cancer. There was also an increase in the number of tweets describing marijuana use as socially normative. Less than 1% of all original tweets expressed a concern about marijuana use.

Content of original tweets versus retweets

About 70% of both the original tweets and retweets had a positive tone, and approximately 5% had a negative tone (Table 4). The original tweets and retweets diverged significantly in their content. The retweets, which tended to be opinions and pithy sayings, included nearly 25% more tweets with a ''general'' subject ($p < 0.001$), and 3% more tweets touting the medical benefits of marijuana. Less than 1% of retweets alluded to a negative aspect of the drug. Original tweets, which tended to relate more to user behavior, had 15% more tweets with a ''self'' subject, and increased mentions of marijuana use, sale, and co-occurring risk behaviors including driving, having sex, or using other drugs or alcohol while high ($p < 0.001$).

Discussion

The findings corroborate those of Cavazos-Rehg et al. Adolescents who use Twitter are exposed to comments about marijuana that are overwhelmingly positive. Whether tweeting or retweeting, individuals used this social network to voice opinions about the medical and social benefits of marijuana, but concerns about the drug were rarely mentioned. Tweet content generally reflected the idea that marijuana was beneficial or harmless. In addition to the general positive tone of the content, roughly 50% of marijuana-related tweets referenced the Twitter user or another identified individual using the drug. Nearly half of tweets sent by users who identified themselves as adolescents mentioned personal use of marijuana. This is potentially significant because social theory suggests that documented use by peers may have an impact on

Table 3. Original Tweet Content Before and After the 2012 U.S. General Election

Code	*Total (N = 36,939) %*	*Before (N = 18,320) %*	*After (N = 18,619) %*	p *Value*
Subject				**<0.01**
Self	51.83	50.72	52.93	
Other	23.22	26.57	19.93	
General	21.94	20.49	23.36	
Unclear subject	3.01	2.23	3.78	
Tone				**0.57**
Positive	68.08	67.94	68.22	
Negative	5.18	5.11	5.26	
Unclear	26.74	26.95	26.53	
Age				**<0.01**
Youth (< 22 years)	5.22	5.46	4.98	
No age provided	94.78	94.54	95.01	
Legality				
Wants more lenient marijuana laws	**5.64**	**9.19**	**2.15**	**<0.01**
Use category				
Refers to own use	**41.50**	**39.75**	**43.22**	**<0.01**
Refers to use by others	**11.64**	**9.83**	**13.43**	**<0.01**
Doesn't refer to use	**46.86**	**50.42**	**43.35**	**<0.01**
Related behaviors				
Refers to habitual use	**1.00**	**0.75**	**1.25**	**<0.01**
Notes social aspect of use	**3.84**	**3.53**	**4.15**	**<0.01**
Sex while high	**1.28**	**1.46**	**1.10**	**<0.01**
Co-occurring alcohol use	4.08	4.27	3.89	0.07
Co-occurring drug use	**2.44**	**2.01**	**2.87**	**<0.01**
Trying to sell marijuana or identifies self as dealer	**1.07**	**0.93**	**1.21**	**0.01**
Can't/doesn't smoke	1.95	1.97	1.93	0.83
Positive aspects mentioned				
Sees marijuana use as a social norm	**1.92**	**1.58**	**2.25**	**<0.01**
Marijuana better/less harmful than another drug	**1.38**	**1.23**	**1.52**	**0.02**
Marijuana not a drug, has no negative impacts	**2.49**	**2.07**	**3.10**	**<0.01**
Marijuana causes relaxation, sleepiness	**2.11**	**1.82**	**2.40**	**<0.01**
Marijuana use to escape/not care about problems	1.06	1.02	1.11	0.42
Marijuana use has other medical benefits	**1.65**	**1.29**	**2.01**	**<0.01**
Other				
Parent referenced	1.72	1.61	1.83	0.11
Medical marijuana referenced	1.51	1.59	1.42	0.18
Pop culture reference or song lyric	15.47	15.61	15.34	0.49
News article	**3.79**	**3.55**	**4.02**	**0.02**

Note: Bolded content denotes a p-value below the threshold of statistical significance ($p < 0.01$).

individual behavior.[19] Previous studies regarding alcohol use found that social modeling had a stronger association with use than other social influences such as perceived norms.[44] Stoddard et al. have suggested that these patterns may also be reflected within online networks.[19] If social patterns surrounding marijuana parallel those regarding alcohol, then documented marijuana use on Twitter represents a potent source of exposure that normalizes the behavior.

The study revealed that adolescents are comfortable broadcasting their own and other's marijuana use on Twitter, as well as discussing other risk behaviors such as drinking, driving, or using other drugs while high. Individual Twitter document their personal use of marijuana and other drugs, creating an online environment that suggests such behavior is normative. Of concern is the finding that parents may reinforce this permissive attitude. Though mediated by the degree of supervision, perceived parental approval appears to impact adolescent marijuana use.[45] Of the 50 tweets by self-disclosed adolescents that referenced a parent, 36% of the references indicated parental support for the adolescent's use of marijuana. These data may not be representative given that these tweets comprise only 2.6% of the total sample, but it suggests a concerning association that merits further investigation.

Perceived norms impact adolescent alcohol and drug use, and the circulating Twitter content suggests marijuana use is harmless if not beneficial.[16] If adolescent behaviors regarding marijuana parallel those around alcohol and drug use, the frequent documentation of use and prevalence of positive opinions about marijuana on Twitter may be associated with increased use within this population.[23,24,29] The legalization of recreational marijuana use in two states was associated with a small but significant shift in more positive attitudes among adolescent use. This shift in adolescent attitudes is likely fostered by the perceived changes in social norms among voters. The fact that nearly all of the retweets were

Table 4. Original Tweet Content ($N=36,939$) Versus Retweet Content ($N=9,095$)

Code	*Original %*	*Retweets %*	p *Value*
Subject			**<0.001**
Self	**51.83**	**36.84**	
Other	**23.22**	**13.99**	
General	**21.94**	**47.80**	
Unclear subject	**3.01**	**1.37**	
Tone			**<0.001**
Positive	**68.08**	**70.45**	
Negative	**5.18**	**4.62**	
Unclear	**26.74**	**24.94**	
Legality			
Wants more lenient marijuana laws	5.64	5.57	0.80
Use category			
Refers to own use	**41.50**	**28.54**	**<0.001**
Refers to use by other people	**11.64**	**9.37**	**<0.001**
Doesn't refer to use	**46.86**	**62.09**	**<0.001**
Related behaviors			
Refers to co-occurring risk behavior	**8.18**	**5.64**	**<0.001**
Refers to habitual use	1.00	1.03	0.79
Notes social aspect of use	3.84	4.18	0.14
Trying to sell marijuana or identifies self as dealer	**1.07**	**0.35**	**<0.001**
Can't/doesn't smoke	**1.95**	**1.54**	**0.01**
Quitting or trying to quit	**0.73**	**0.27**	**<0.001**
Positive opinion			
Sees marijuana use as a social norm	1.92	**3.63**	**<0.001**
Sees medical benefit to marijuana	**5.13**	**8.73**	**<0.001**
Other			
Parent referenced	**1.72**	**1.32**	**0.01**
Medical marijuana referenced	**1.51**	**0.81**	**<0.001**
Pop culture reference or song lyric	**15.47**	**12.56**	**<0.001**
News article	**3.79**	**2.57**	**<0.001**
Advertisement for online publication	1.09	92.00	0.16

Note: Bolded content denotes a p-value below the threshold of statistical significance ($p<0.01$).

positive comments about marijuana may also reflect the changing norms about its use. Future research examining the relationship between displayed marijuana content, peer's displayed content, and marijuana use is needed. Awareness efforts may be needed to combat the information and misinformation circulating about marijuana and account for the growing political and social support for the drug, perhaps using the social media networks themselves to disseminate such content.

Limitations

This study has limitations to consider. First, the keyword queries were designed to be representative of the common themes and tone of the conversation about marijuana occurring on Twitter. However, in only using queries where >30% of the results from an initial search with Twitter's native search tool were related to marijuana, the full breadth of the Twitter discussion on marijuana may not have been captured. Another limitation was that the age information in this study was self-reported and relatively scant.

Conclusions

The findings suggest that adolescents who use Twitter, whether they disclose age or not, are exposed to a robust, largely positive discussion about marijuana that normalizes its use. Twitter is increasingly becoming an outlet for individuals to reveal their own marijuana use, and the health risks of marijuana are not being discussed. The high proportion of adolescents broadcasting their use and the indications of parental support of are concerning and merit further investigation. This is likely to increase in importance as the legalization of recreational marijuana use spreads across the country.

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