Using Twitter Post Data to Ascertain the Sentiment of Alcohol-related Blackouts in the United States

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Abstract

Research shows variability in how alcohol-related blackouts (periods of memory loss during/after drinking) are subjectively evaluated. We accessed 3.5 million original Tweets written in the U.S. between July 2009 and February 2020 that referenced blackouts, and coded the sentiment (positive or negative) of those Tweets, using the machine learning function of a Twitter-sponsored commercial platform. The sentiment of Tweets was examined by day of week and compared to the sentiment of blackout Tweets on certain holidays to non-celebration matched days. Tweets were more likely to have a positive (73%) than negative sentiment, and positive Tweets were more common during weekends. Relative to typical non-celebratory weekends, a greater proportion of blackout Tweets were positive around Thanksgiving and New Year's Eve, though differences were not observed relative to several other celebratory periods (e.g., Superbowl). Results have implications for online interventions, which can use social networking sites to target alcohol during high-risk periods.

Keywords: alcohol, blackouts, Twitter, sentiment coding

1. Introduction

Alcohol misuse is a significant, global public health problem, resulting in injuries, mental and behavioral disorders, and non-communicable diseases (WHO, 2018). One specific consequence of alcohol misuse is alcohol-related blackouts, periods when an individual has failed to encode memory for events during or after drinking (Wetherill & Fromme, 2016). Blackouts are not only frequent (Barnett et al., 2014) but also associated with other negative outcomes including embarrassing oneself, hangover (Merrill, Boyle, et al., 2019), injuries, and regrettable sexual experiences (Mundt et al., 2012; Valenstein-Mah et al., 2015). Furthermore, blackouts are shown to predict alcohol use disorder later in life (Studer et al., 2019).

Despite their seeming severity, research suggests that some drinkers who experience blackouts do not necessarily perceive alcohol-related blackouts to be negative experiences. Previously, attitudes toward alcohol-related blackouts have primarily been assessed in samples of college students. In one such sample, when asked how much a range of consequences bothered the college students who experienced them, data indicated blackouts ("I couldn't remember some part of the day or night") were one of the least bothersome consequences of those assessed, with an average score of 1.31 on a scale where 1=a little bothersome and 2=somewhat bothersome (Barnett et al., 2015). In another study, similarly low-to-moderate ratings of the extent to which blackouts are negative were reported, even when assessing a more severe form of blackouts ("Not able to remember large stretches of time") (Merrill et al., 2013). Qualitative data also indicate that blackouts are sometimes perceived as neutral, rather than negative experiences (Merrill, Miller, et al., 2019), and are viewed as common and acceptable among college students (Merrill et al., 2021).

The above-mentioned studies are limited not only by a sole focus on college students, but also by their methods, using only self-report surveys (Barnett et al., 2015; Merrill et al., 2013), focus groups (Merrill, Miller, et al., 2019) and individual interviews (Merrill et al., 2021; White et al., 2004). Each of these methods may suffer from retrospective bias, social desirability bias, and/or small sample sizes. As an alternative method of data collection, public posts on social networking sites can be used to measure attitudes toward blackouts on a much broader scale and within a sample that extends beyond only young adults currently enrolled in college.

Twitter, a platform where users post "Tweets" (short text-based messages) that others can like, comment on, or share, is among the most popular social networking sites (Perrin & Anderson, 2019; Smith & Anderson, 2018). Data from this platform are

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increasingly being used in research to understand alcohol use behavior (Curtis et al., 2018; Weitzman et al., 2019; West et al., 2012). Among the valuable findings from this body of work, it has been shown that the majority of alcohol use references online are pro-alcohol (Cavazos-Rehg et al., 2015). The extent to which the sentiment of Tweets about blackouts in particular are positive versus negative is also important, as positive depictions could normalize or even glorify this notably risky outcome of drinking. However, the way blackouts are described and depicted on social media is less well-studied. In our own work, using a relatively small subsets of Tweets, we found that people often wrote online expressions of celebratory reasons for blacking out (e.g., desire to blackout for one's birthday), suggesting that blackouts may be a desirable, rather than feared outcome (Riordan et al., 2019). Second, in line with prior research among young adults (Merrill, Miller, et al., 2019), we observed descriptions of presumably recent blackouts on Twitter that were both negative (e.g., experienced other regretted consequences) and positive (e.g., blackouts as a shared social experience) (Merrill et al., 2020; Riordan et al., 2019). Similar to other Twitter-based studies, the small number of Tweets we were able to access (~1–5%) using the Twitter Application Programming Interface (API) limited the ability to measure trends and/or generalize to a larger segment of the population.

Paid platforms, such as Crimson Hexagon (Breese, 2016; Chan et al., 2018; King, 2014), have the advantage of allowing access to all historic Tweets, and machine learning techniques can allow a larger volume of Tweets to be coded. In extension of our prior work that used this tool to focus on the *presence* of blackout Tweets (Riordan et al., 2022), the current study focuses on *attitudes* about blackouts. According to Self-Presentation Theory, social media posts are intentional and tangible representations of self (Jensen Schau & Gilly, 2003). Research indicates that an individual's self-presentation on social media aligns with their alcohol use (Litt et al., 2018; Moreno et al., 2016), consistent with Self-Presentation Theory, and suggesting social media posts may also provide powerful fodder for understanding attitudes toward blacking out. Clarifying whether such attitudes are more positive during certain periods of time may be helpful to inform intervention and prevention timing (Neighbors et al., 2011). Indeed, while blackouts may be considered inappropriate during certain times (e.g., during the typical work week), they may be a socially acceptable or even desirable consequence during holidays or celebrations. Moreover, the times of week and year that attitudes toward blackouts appear more positive may not necessarily map onto the times of week and year that blackouts are most common, as explored in our prior study (Riordan et al., 2022). Knowing when people may have positive attitudes toward this objectively negative outcome of drinking can inform times when broad scale efforts to change such attitudes (e.g., social media campaigns in opposition of heavy drinking) might be deployed.

As noted earlier, self-report and interview methods to understanding attitudes may result in bias, and the small subsets of Tweets that are accessible via Twitter's API limit generalizability. One alternative – sentiment analysis – involves identifying and classifying the sentiments (e.g., positive, negative) that are expressed in text about an object, behavior, or topic. Applying such analyses to the vast amount of data present on Twitter can be especially useful in understanding attitudes about blackouts. Although one of the main benefits of using platforms like Crimson Hexagon for a sentiment analysis is access to all historic Tweets, researchers are restricted to use of the platform's machine learning tool (BrightView™), which does not offer accuracy statistics. However, previous work has suggested that BrightView is relatively accurate when compared to human annotators when using simple categories (e.g., positive, negative, neutral for sentiment) (Riordan et al., 2022; Riordan et al., 2021).

In the present study, we examine all public domain Tweets in the U.S. from January 2009 to January 2020 to (a) determine the extent to which Tweets reference blackouts as positive (i.e., pro- blackout) vs negative (i.e., anti-blackout), and (b) test the hypotheses that blackout-related Tweets more often have a positive (vs negative) sentiment during (i) weekends and (ii) celebratory/holiday periods. Further, in a particularly novel extension of prior work, (c) we tested the hypothesis that the sentiment of blackout Tweets the day leading up to specific holidays (i.e., in anticipation of drinking) would more often be positive than the day after a holiday (after which any negative outcomes of a drinking event have already occurred).

2. Methods

2.1. Procedures

In order to access and identify all historic blackout Tweets written in the United States between January 1, 2009 to January 31, 2020, we used Crimson Hexagon (now Brandwatch) and their BrightView™ machine learning tool. Specifically, we used Crimson Hexagon to access every Tweet that referenced a blackout ("blackout" OR "black out" OR "blacked out" OR "blacks out" OR "blacking out") yielding a sample of 17.5 million. Following this first step we used ForSight's Topic Wheels and clusters to remove keywords that were consistently associated with non-alcohol blackouts (e.g., Call of Duty) narrowing our

sample to 9.2 million. As a final step, we trained BrightView™ using a sample of alcohol-related Tweets identified by the researchers (e.g., "Can't wait to get blackout drunk") and non-alcohol-related (e.g., "Power blackout in NYC"). BrightView recommends training 200 posts. However, to train BrightView, three alcohol researchers (all with experience coding blackout Tweets) coded 1,900 examples to 100% agreement as blackout or not blackout. Posts that could not be agreed upon were not used for training to provide the "best examples" as recommended by Crimson Hexagon. These data were then used to train BrightView. After the machine learning process, we had a pool of 3.5 million alcohol-related blackout Tweets.

To code sentiment, we again employed the BrightView machine learning tool. Using previous literature to guide our coding (Cavazos-Rehg et al., 2015), Tweets were coded as either positive or negative (Table 1). First, three alcohol researchers (all with experience coding blackout Tweets) coded 1,900 Tweets as positive or negative, and discussed discrepancies until reaching 100% agreement. These data were then used to train BrightView.

2.2. Analysis Plan

To determine whether sentiment differs by time, we first descriptively compared the overall proportion of positive vs. negative blackout Tweets. Second, we calculated proportions for positive vs negative sentiment of posts by day of the week and used an equality of proportions test to compare whether those proportions differed. Third, we compared the proportion of positive and negative Tweets on "typical weekends" and the following US celebration/holiday periods: New Year's Eve, Superbowl Sunday, St. Patrick's Day, Cinco de Mayo, Labor Day, Halloween, Thanksgiving, and Christmas. This subset of particular celebratory periods was selected as each is known to commonly involve alcohol consumption among people in the U.S. We elected not to focus on holidays less likely to involve heavy drinking (e.g., Easter Sunday), or those that would be specific only to subgroups of people or vary across individuals in timing (e.g., Spring Break among college students). Our prior work showed blackout Tweets were posted both leading up to (Riordan et al., 2019) and the day after a drinking event (Merrill et al., 2020). As such, we included the day before, day of, and day after the celebration as part of the holiday/celebration period. We compared the proportion of blackout posts with positive sentiments during these holiday periods to the proportion observed on non-celebration weekends (Friday, Saturday, Sunday) in the same year (to account for differing levels of Twitter usage over time), using paired t-tests. Finally, we used an equality of proportions test to compare the proportion of Tweets with a positive sentiment between the day before, day of, and day after the holiday.

3. Results

3.1. Sample Descriptives

Demographic data were available for the Tweeters of only 15% of all Tweets, but provide some insight into the sample. Among these, 44% were written by women. Additionally, 11% were written by adolescents (under age 18), 62%, by young adults (age 18-24), 15% by those age 15-24, and 13% by those age 35 and older.

3.2 Sentiment of Blackout Tweets Overall and by Day of Week

Of the 3,519,142 blackout Tweets, the majority (73.2%; 2,576,542) were positive. As seen in Figure 1, there was a difference in the proportion of blackout Tweets that had a positive sentiment (χ^2 (6) = 12053, p < .001), such that it was highest leading into and through the weekend days typically associated with drinking (Thursday = 73.7%, Friday = 76.8%, Saturday = 76.5%). The proportion of blackout Tweets that were positive on other days was as follows: Monday = 70.1%, Tuesday = 70.3%, Wednesday = 72.0%, and Sunday = 71.7%.

Table 1. Types and examples of Tweets categorized as positive versus negative valence

Positively-Valenced	**Example Tweets**
Positive prior experience with blackout	*Loved getting drunk and blacking out with my bestie!*
Intention to black out	*Can't wait to blackout tonight!*
Encouraging others to black out	*Happy birthday! Make sure you blackout, or it didn't happen*
Positive reference to others' blackout	*I love when [name] gets blackout drunk. Too funny!*
Negatively-Valenced	
Negative prior experiences with blackouts	*I blacked out, fell down stairs, and woke up in pain.,,I hate drinking*
Intention to not blackout	*Big night tonight, definitely not going to blackout this time*
Discouraging others from blacking out	*Have a great night tonight! Don't blackout!*
Negative reference to others' blackout	*If you get blackout drunk and can't control what you're doing, you're an arsehole*

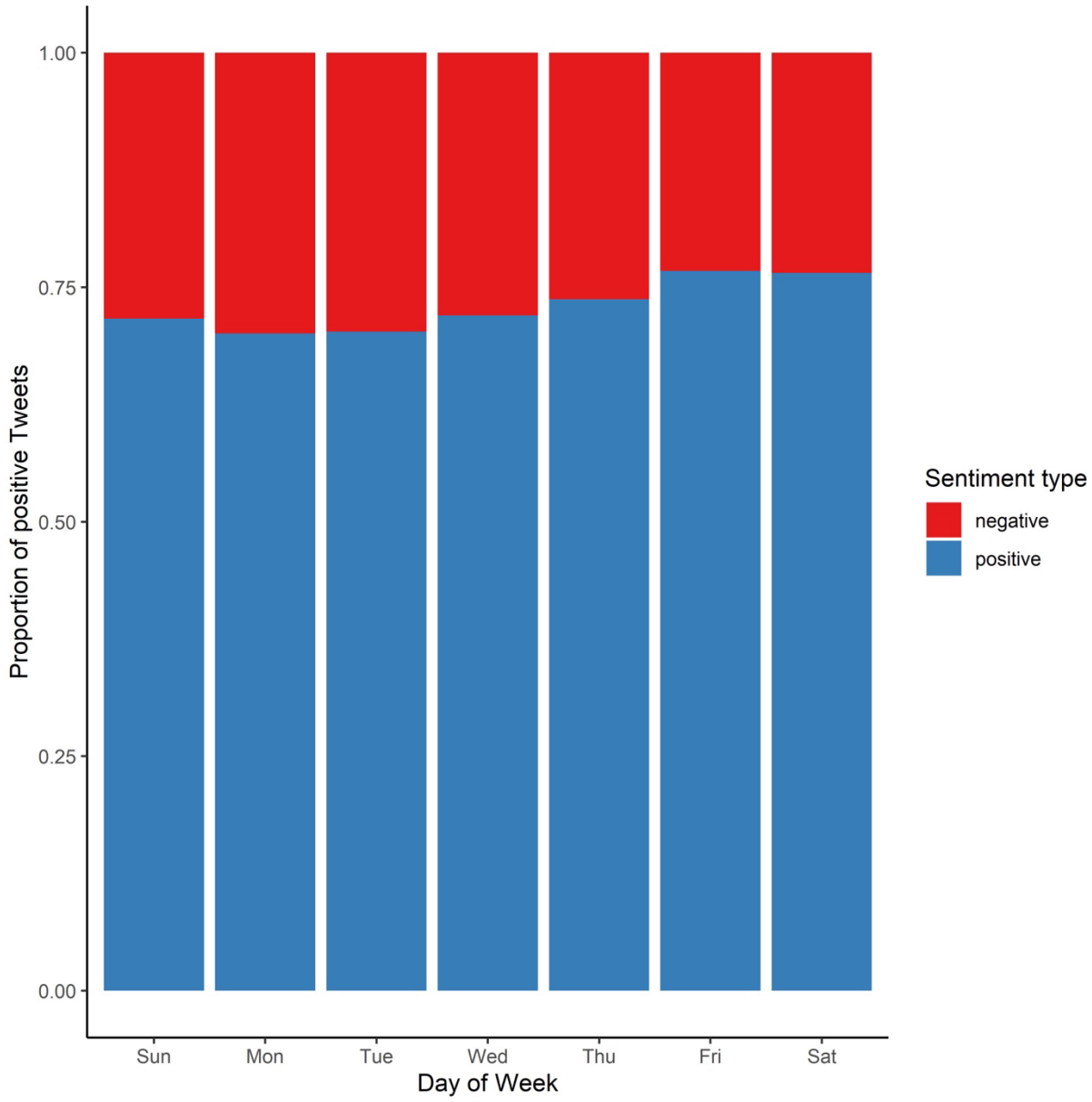

Figure 1. Proportion of positive Tweets written on each day of the week.

Table 2. Proportion of positive blackout Tweets on celebration periods vs typical weekend

Celebration	Proportion Positive	*t (9)*	*p*	Cohen's d
Typical Weekend	69.6	-----	----	----
Thanksgiving	91.0	3.75	.005	1.19
New Year's Eve	76.9	2.78	.021	0.88
Superbowl	79.3	2.10	.065	0.66
Halloween	73.0	0.56	.588	0.18
Christmas	68.3	-0.18	.857	-0.06
Labor Day	68.3	-0.56	.588	-0.18
St. Patrick's Day	68.2	-0.62	.548	-0.20
Cinco de Mayo	67.3	-0.82	.435	-0.26

3.3 Sentiment of Blackout Tweets by Holiday/Celebratory vs Non-Celebratory Periods

Figure 2 shows a raincloud plot of the number of blackout-related and alcohol-related Tweets written on St. Patrick's Day, Cinco de Mayo, Thanksgiving, Christmas, New Year's Eve, Labor Day, Superbowl Sunday, and Halloween compared to non-celebration weekends. When compared to a weekend without a holiday (mean positive proportion = 69.6%), the proportion of blackout-related Tweets that were positive was higher for Thanksgiving and New Year's Eve only (Table 2).

Figure 3 shows the proportion of Tweets that were positive the day before, day of, and day after each *specific* holiday/celebratory period. Aggregating across celebratory events, Tweets were more likely to be positive when written the day of the celebration (82.3%), than the day before (78.8%), or after (80.7%; χ^2 (2) = 415.49, $p < .001$).

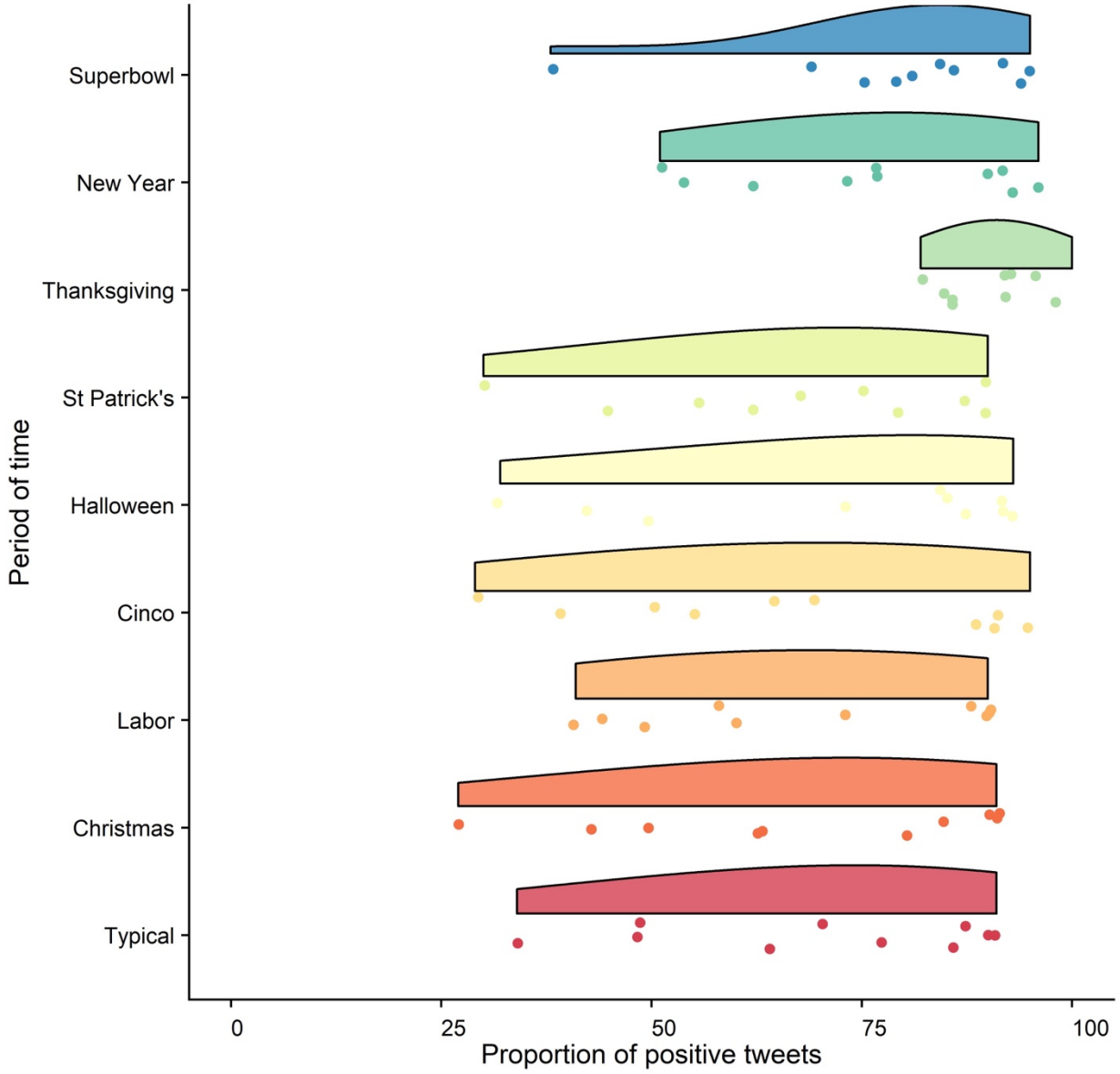

Figure *2.* A raincloud plot for the percentage of positive Tweets by celebration. Note that a raincloud plot combines a scatter plot (percentage of positive Tweets for each event), a box and whisker plot (median and interquartile range), and a half violin plot (density).

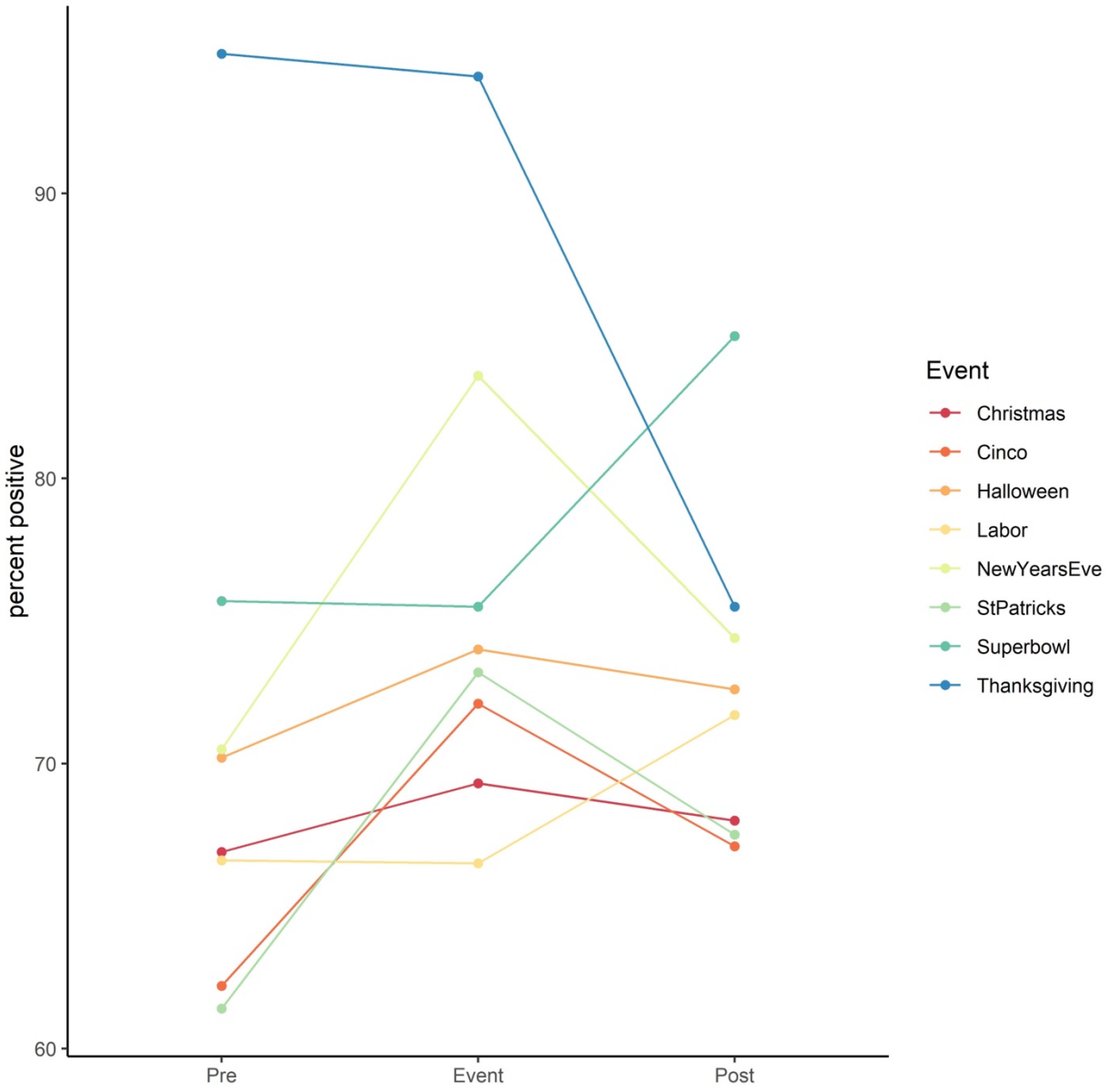

Figure 3. Percentage of positive blackout Tweets written the day before, day of, and day after each event.

4. Discussion

We aimed to determine tendencies for the sentiment of Tweets about alcohol-related blackouts to be positive versus negative, as well as whether sentiment varied by day of week or certain holidays (relative to a typical non-holiday weekend). Strengths of this study include the large sample of publicly available Tweets for analysis that spanned all states in the U.S. and a period of 11 years. These unique data provided a window into the valence of people's thoughts related to blackouts outside of a research study where certain biases may be present. Specifically, findings provide novel insight into the extent to which, and precisely when during the week and year, blackouts may be perceived as a desirable rather than harmful outcome of drinking.

Most Tweets about alcohol-related blackouts had a positive sentiment (73%); positive alcohol-related blackout Tweets were almost three times more common than negative blackout Tweets (27%). Prior work on the subjective evaluation of blackouts has not quantified how many *people* tend to view blackouts as positive versus negative, or on how many drinking occasions they are viewed as such. However, our data make clear that the way blackouts are presented on social media is

largely positive. There are a number of potential reasons why this may be the case.

First, our prior study showed that Tweets were often written late night or early morning (Riordan et al., 2022), which may be immediately before or after a blackout experience. The fact that many of these Tweets may be written while still under the influence of alcohol, prior to learning about any negative consequences (e.g., embarrassment) that accompanied one's blackout, might help to explain why such Tweets tend to be more positively-valenced. Second, prior work supports that some individuals find blackouts to be amusing, funny and exciting (Merrill, Miller, et al., 2019; White et al., 2004). This may be especially the case under certain conditions such as when the blackout is experienced in a comfortable and safe environment, is perceived favorably by one's friends, or is not accompanied by any negative consequences (Merrill, Miller, et al., 2019). Individuals who have more experience with blackouts may be those that view them more positively (Merrill, Miller, et al., 2019) and perhaps also those who are more likely to post about them. Another possibility is that the Tweets included in our analysis were not necessarily reflective of "true blackouts" in which long periods of memory are completely lost, but a less severe form of memory loss and/or simply intoxication (Ward et al., 2021). Finally, theory and prior research (Schlosser, 2020) suggest a bias toward positive self-presentation online. As such, the way blackouts are presented online (in a largely positive manner) may not fully capture the reality of what people think and feel about this outcome of drinking. Nonetheless, our finding is concerning, as the public discussion of blackouts in a positive light may normalize the experience of a blackout, downplay the severity of it, and perpetuate an idea that a blackout is a positive experience. This is particularly concerning given the sheer volume of positive blackout-related Tweets and given that blackouts are often associated with other harms and predict subsequent substance use disorders.

We also found that the proportion of Tweets that are positive versus negative tends to be greater leading into (Thursday) and on the weekends (Friday, Saturday) relative to weekdays, consistent with our prior work demonstrating that this is also when blackout Tweets are more common (Riordan et al., 2022). Moreover, we identified two particular holidays where the proportion of blackout Tweets that was positive was particularly high—Thanksgiving and New Year's Eve. Our examination of Thanksgiving included what has anecdotally been termed "Blackout Wednesday" or "drinksgiving," one of the heaviest drinking days of the year. No research has been conducted on drinking behavior specific to this holiday, despite that it may be one where extremely risky behavior marked by negative consequences can be expected. To inform interventions, researchers might seek to better understand exactly *why* this day involves heavy drinking (i.e., mechanisms) and *for whom* (i.e., moderators). Anecdotally, this may be a time where college students get together with hometown friends, and together celebrate newfound freedoms, successes, and their reunion. Whether other groups are also at risk, and why, is yet to be empirically demonstrated.

In turn, the day before Thanksgiving may be an ideal candidate for event-specific prevention approaches (e.g., Neighbors et al., 2009). For example, U.S. colleges could provide preventive intervention materials (e.g., reminders of how to use protective behavioral strategies when drinking, in order to reduce harms) prior to students leaving for this particular holiday break. Alternatively, social media campaigns could be launched across the U.S. to highlight the risks of heavy drinking in the days leading up to Thanksgiving. Given the overall positive sentiment of blackouts demonstrated in this study, perhaps social norms correction, wherein people are informed that others do not in fact hold positive attitudes about blackouts, could be useful. Further still, perhaps individuals who write online posts with positive sentiments in anticipation of blackouts could be identified in an automated fashion, and provided intervention materials or encouragement to receive an alcohol assessment. As all of these ideas are speculative, future research is needed to determine the types of intervention methods that would be most valuable for reduction of drinking risk around Thanksgiving, or any other holiday, and for the largest number of individuals.

Our primary analyses described above involved comparing the sentiment of blackout Tweets on typical weekends to holiday periods, encompassing the day before, day of, and day after. However, we considered the possibility that more positive Tweets leading up to (e.g., in positive anticipation of) the holiday could "wash out" any negative Tweets written after a holiday (e.g., in regret). As such a pattern could obscure overall findings, we took a more nuanced, descriptive approach to examining the sentiment of Tweets on each of the three days that comprised each celebratory period. The average trend observed across the holidays examined was that Tweets were most positive the day of a holiday, relative to the day before and after. Interestingly, this overall trend was most apparent for New Year's Eve, and was *not* characteristic of the Superbowl, where blackout Tweets were more often positive the day afterwards. The extent to which the proportion of blackout Tweets that were positive dropped the day after was most pronounced for Thanksgiving. These findings highlight that perceptions of blackouts as a desirable vs. undesirable outcome of drinking may depend not only on a given holiday, but the precise day surrounding that holiday.

Importantly, it is difficult to ascertain the extent to which positively-valenced Tweets about blackouts accurately reflect the prevalence of positive attitudes. In line with self-presentation theory (Jensen Schau & Gilly, 2003), Tweeters may tend to highlight their positive experiences and downplay their negative experiences online, which may have biased the degree to which our results reflect true attitudes. Prior literature supports a link between posting of content on social media about alcohol and self-reports of one's own alcohol use (Litt et al., 2018; Moreno et al., 2016), but the extent to which the valence of posted content relates to one's own attitudes about drinking behavior has yet to be studied. This is a recommended future direction. However, the way a Tweet is written has important implications, regardless of whether it accurately reflect one's beliefs, in that it may serve to influence perceptions of blackouts as normative, acceptable, and even desirable among others who read such Tweets.

4.1. Limitations

First, BrightView's machine learning algorithm, used to remove non-alcohol-related blackout Tweets and identify sentiment, does not offer any accuracy statistics. Previous studies using BrightView have found that it is relatively accurate when using simple categories like sentiment. For example, a previous test on identification of cannabis Tweets found 87% accuracy (Riordan et al., 2022; Riordan et al., 2021). Use of BrightView may, however, limit replicability, as only researchers with a Brandwatch subscription will have access to this tool, and the algorithm itself has been updated since our study. Second, our search term process was designed to be sensitive to detecting blackouts, which may have come at the expense of high specificity (i.e., failure to capture all references to alcohol-related blackouts). Third, our analyses report the number of positive versus negative Tweets written, without respect to how many separate Tweeters they came from. Fourth, all Tweets were "forced" into positive versus negative categories, as such a small portion of Tweets were "neutral." If there was bias in the extent to which more neutrally-valenced Tweets were coded one way or the other, it is possible that findings would differ had we included a third (neutral) category. Likewise, our analysis does not reveal anything about precisely how positive or negative individuals perceive blackouts to be; future work using more advanced machine learning techniques that allow for continuous coding of sentiment strength will be useful. It is also important to note that we limited the present study only to Tweets that originated in the U.S. and were written in English. Likewise, we focused only on a subset of celebratory periods/holidays, all of which are typically celebrated in the U.S., and some of which are more well-known for alcohol use (e.g., St. Patrick's Day) than others (e.g., Christmas) Future work on the sentiment of blackout Tweets in other regions of the world and on a greater range of holidays is warranted.

Finally, we were unable to fully demographically characterize our participants. Of those with known information, the majority were young adults, and findings may be less likely to generalize to older or young individuals. Further, to the extent that certain demographic groups are more or less likely to use Twitter, even if not more or less likely to black out, our results may be biased. Future research could be used to identify whether certain demographic groups (e.g., young adults, those of different racial/ethnic subgroups) are more likely than others to discuss blackouts in a positive versus negative manner online.

4.2. Conclusions

Social media provides a venue to broadcast thoughts, feelings, and experiences to a large network of individuals—including people that the Tweeter/poster might not be directly connected. Material on these platforms has been shown to influence perceptions of drinking or social norms. The fact that posts about alcohol-related blackouts were primarily positive, especially around certain holidays, is of particular interest. Such positively-valenced Tweets unfortunately may normalize drinking to the point of not remembering, serve to perpetuate heavy drinking, and interfere with personal recognition of problematic drinking patterns. Online efforts to counteract the spread of positive views about blackouts (e.g., public service announcements highlighting the harm of alcohol-induced memory loss, social norms campaigns providing information on the true prevalence of blackouts) may be a fruitful future endeavor. Targeting such efforts around weekends and the holidays observed to be riskiest in the present study—Thanksgiving Eve and New Year's Eve—may have the greatest impact.

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