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Alcohol Expectancy Associates as a Probe of the Motivational Processes that Lead to Drinking

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by

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Abstract

Consistent with theory, within-person alcohol expectancies monitored across a day predicted alcohol consumption levels later that day. These correlational findings could have been a function of any number of "third variables" including social influences or temporal cycles in affective state. To strengthen the inference that changes in expectancies validly reflect changes in the motivation to drink, we experimentally manipulated expectancy activation and measured subsequent changes in expectancy reports. The evening before expectancy monitoring, participants were informed that later the next day—a Monday, Tuesday, or Wednesday—they would be participating in a solitary taste-test of either alcohol or soft drinks. Alcohol expectancies were then measured across four timepoints in the day that culminated in an in-laboratory taste-test. Alcohol expectancies in the alcohol condition were hypothesized to increase across the day as participants anticipated drinking alcohol, in contrast to the soft drink condition, in which expectancies were predicted to stay relatively unchanged. Unfortunately, data collection was prematurely concluded once COVID-19 social distancing guidelines were issued. As a consequence, multilevel modeling results could not be considered statistically reliable due to an underpowered dataset. Graphical representations of the data suggested that alcohol expectancies from the alcohol condition were more positive than those from the soft drinks condition, although some anomalies also appeared. Alcohol expectancies were not related to alcohol consumption quantities during the taste-test. Between group differences in alcohol expectancies provided some mixed evidence—although not statistically reliable—that alcohol expectancy associates were affected by the experimental manipulation of the anticipated drinking event.

Introduction

The ability to use past experiences to anticipate the potential future outcomes of activating certain behaviors in certain contexts, and to motivate behavior accordingly, is clearly more advantageous for survival than reactions to prior events—some would argue that it is possibly a universal principle of neurobiological processing (Bar, 2010). Multiple areas of research exemplify the range of anticipatory processing effects by bringing to light the similar ways in which the human body activates (from neurobiological to behavioral levels) in anticipation of future responses to a drug or treatment. In several placebo analgesia studies (Benedetti, 1996; Grevert, Albert, & Goldstein, 1983; Levine & Gordon, 1984; Levine, Gordon, & Fields, 1978), participants who reported pain relief after receiving a placebo pain reliever (expected effects) also reported pain increases after receiving naloxone (an opioid antagonist), concluding that endogenous opioids were responsive to the placebo treatment and responsible for the reported pain relief. These findings underscore how simply expecting/anticipating outcomes can activate actual physiological changes within the body. Similarly, on the behavioral level, researchers studying the effects of alcohol using a balanced-placebo design found that behaviors commonly associated with the physiological effects of alcohol consumption were explained by alcohol expectancies, or the information that can be solicited from people of how alcohol affects people (Hull & Bond, 1986; Marlatt & Rohsenow, 1980). These findings, taken cumulatively with the placebo findings, demonstrate a conceptual overlap in which both concepts refer to fundamental anticipatory processes that use aquired information to guide physiologial/behavioral changes. The extent of the overlap has led researchers to assert that the concepts of placebo effects and expectancies should be considered interchangeable (Benedetti, Carlino, & Pollo, 2011).

Like placebo effects and expectancies, motivation has been characterized as an anticipatory process, being referred to as a "useful summary concept for how an individual's past history and current state interact to modulate goal-directed activity" (Simpson & Balsam, 2015, p. 3)—that is, certain behaviors are activated (i.e., motivated) in anticipation of obtaining future goals. The obvious overlap between these terms (i.e., placebo, expectancy, motivation) brings into focus a larger conceptual framework that incorporates multilayered processes, from the neurophysiological to the behavioral, that are associated with using acquired information to guide behavior. While considering expectancies within this larger conceptual framework (as a concept that highlights the future-oriented aspects of guiding behaviors) and the extensive and robust associations between alcohol expectancies and drinking levels, researchers have theorized that alcohol expectancies are an integral part of the motivational processes that lead to drinking alcohol (see Goldman, 2002; Goldman, Reich, & Darkes, 2006). And if expectancies (anticipation), placebo, and motivation are all differing aspects of the processes that guide behavior, it may be possible to measure alcohol expectancies as a probe of the motivation to drink alcohol.

For decades, alcohol expectancies have been probed using a wide variety of questionnaire measures (e.g., Alcohol Expectancy Questionnaire [Brown, Christiansen. & Goldman, 1987]; the Comprehensive Effects of Alcohol Scale [Fromme, Stroot, & Kaplan, 1993]; the Alcohol Expectancy Multiaxial Assessment [Goldman & Darkes, 2004]; the Anticipated Effects of Alcohol Scale [Morean, Corbin, & Treat, 2012]) across a variety of age groups, including children (Christiansen, Goldman, & Inn, 1982; Christiansen, Smith, Roehling, & Goldman, 1989; Dunn & Goldman, 1996; Miller, Smith, & Goldman, 1990), adolescents (Christiansen et al., 1989; Montes et al., 2017), and adults (Brown et al., 1987; Brown, Goldman, & Christiansen, 1985; Lee, Greely, & Oei, 1999). Alcohol expectancies have been consistent predictors of drinking levels (e.g., Boyd, Sceeles, Tapert, Brown, & Nagel, 2018; Brown et al., 1985; Smith & Goldman, 1994) over timeframes from within a day (Benitez & Goldman, 2017; Patrick, Cronce, Fairlie, Atkins, & Lee, 2016) to across a year (e.g., Christiansen et al., 1989) and have been shown to be predictive of when adolescents binged alcohol and got drunk for the first time (Jester et al., 2015).

Beyond the list of studies displaying the predictive relationship between alcohol expectancies and drinking levels, alcohol expectancies have been found to exhibit temporal patterning consistent with drinking patterns. For example, positive alcohol expectancies have been found to be higher on weekends than on weekdays (Armeli et al., 2005; Lee et al., 2018), which clearly aligns with young adults tendency to binge drink on Thursday, Friday, and Saturday than on other days of the week (Del Boca, Darkes, Greenbaum, & Goldman, 2004; Finlay, Ram, Maggs, & Caldwell, 2012; Maggs, Williams, & Lee, 2011; Reich, Cummings, Greenbaum, Moltisanti, & Goldman, 2015). Research also indicates that alcohol expectancies exhibit contextual patterning consistent with drinking patterns. For example, being with friends and/or being in a pub/bar/club setting has been associated with heightened alcohol expectancies as compared to other social contexts (e.g., with family or work colleagues) and environmental settings (e.g., home or work; Monk & Heim, 2014), which aligns with findings indicating that people drink more when more friends are around (Thrul & Kuntsche, 2015).

The temporal covariation between alcohol expectancies and drinking has also been shown to occur across time periods as short as a day (Armeli et al., 2005; Benitez & Goldman, 2017; Patrick et al., 2016; Richton, Armeli, & Tennon, 2017). Armeli and colleagues (2005) found that day-to-day, within-person fluctuations of alcohol expectancies were predictive of the decision to drink and the number of drinks consumed later that day. As part of a larger study, participants were asked to log onto an internet website for 21 days in a row and report their drinking levels from the previous night and to rate how desirable or undesirable four alcohol outcome expectancies would be that evening. The four alcohol expectancies were reduced tension from drinking alcohol, a sense of carelessness from drinking alcohol, physical impairment (becoming clumsy or uncoordinated) from drinking alcohol, and a pleasant feeling from drinking alcohol with friends. The results indicated that higher alcohol outcome expectancy desirability ratings were associated with more same-day decisions to drink and more drinks consumed while controlling for weekly drinking cycles.

In another study from the same laboratory (Richton et al., 2017), afternoon tension-reduction expectancies and impairment expectancies were predictive of the decision to drink and the number of drinks consumed later that evening. In this study, participants were asked to log onto an internet website for 30 days in a row to report their drinking levels from the previous night and to rate how likely drinking would make them "feel less tense" and "become clumsy or uncoordinated" if they were to drink that evening. Participants were allowed to participate in this 30-day study once per year for up to four years (M = 3.2 years). On days with ratings of higher expectancy likelihood, participants were more likely to drink later that evening and to consume more on drinking days.

Following the same pattern of results, Patrick and colleagues (2016) found that day-to-day, within-person fluctuations of alcohol expectancies were predictive of high-intensity drinking. As part of a longitudinal study, expectancies were assayed once per day within a larger study wherein participants were assigned to complete questionnaires three times a day (morning, afternoon, and evening) for two randomly assigned weeks four times in one year (once a quarter). Participants completed the questionnaires over the phone with an Interactive Voice Response (IVR) system. To evaluate alcohol expectancies, participants were asked, “If you were to drink tonight, how likely would you be to feel or do the following things?” (p. 111). To this prompt, participants rated each of 13 provided alcohol-related expectancies (6 positive and 7 negative) on a 9-point scale (very unlikely to very likely). Drinking quantity for that day was reported during the IVR interview the following morning. They found that higher within-person alcohol expectancies were associated with more high-intensity drinking while accounting for age, sex, fraternity/sorority membership, weekend vs. weekday, week of the year, and social contexts.

Although these studies examined how alcohol expectancies predicted drinking behaviors, none probed alcohol expectancies more than once in a day. Evidence of tighter temporal linkage (i.e., within-day alcohol expectancy fluctuations that predicted drinking levels) would provide stronger evidence that anticipatory processes are a part of the motivational processes that lead to drinking alcohol. A challenge in measuring within-day alcohol expectancy fluctuations, however, comes from the way in which alcohol expectancies are usually measured. Many measures, like the ones previously mentioned, require participants to respond to a list of items that they believe best describes themselves in regard to drinking alcohol. This burden placed on participants to consider different expectancies on scales that they may not have considered before may add layers of processing that move them away from in-the-moment responses. Ideally, probes of momentary alcohol expectancy processes would be as unobtrusive as possible so that responses reflect current and spontaneous manifestations of motivational processes.

One approach to measuring alcohol expectancies in a less obtrusive way comes from the extensive research on free association (Nelson, McEvoy, & Dennis, 2000; Nelson, McKinney, Gee, & Janczura, 1998), in which participants respond with the first word that comes to mind when given a cue. Nelson and colleagues (2000 & 1998) suggested that meaningful associations to cues are activated in the brain based on the previously created relationships of items stored in memory; and although the relationships of items can be mathematically characterized, they are not consciously accessible to the individual. For example, as applied to alcohol expectancies, when an individual is asked to rapidly respond to the cue, "Alcohol makes me _________" (Reich & Goldman, 2005; Reich, Below, & Goldman, 2010), an associate emerges in their mind, outside of their awareness of how that word was selected, based on that individual's past experiences and modified according to the individual's current contextual circumstance (Nelson et al., 1998). For this reason, the associate selection processes that occur before an associate has been emitted have been considered to be implicit by memory researchers (Nelson et al., 2000 & 1998; Rooke, Hine, & Thorsteinsson, 2008; Stacy, Ames, & Grenard, 2006).

Although using expectancy association may be considered a more implicit measure of alcohol expectancies than other measures (Goldman et al., 2006; Reich, Below, & Goldman, 2010), responses to the prompt may not be entirely implicit. Initial, effortless associations that come to mind and are emitted may be considered implicit associations. Once the initial associate emerges, however, an individual may edit their association before speaking. Thus, quickly and less effortfully provided associates should contain measurable contextual information/variability.

Another challenge to measuring the fluctuations of alcohol expectancies across a day is the way in which the measurement device is delivered to the participants. Requiring participants to visit the laboratory several times per day would gain us the several time points of data needed to measure the changes over time but would prevent us from capturing the variance due to the naturally occurring contextual changes that happen in daily life. One technique that has been gaining popularity due to its ability to capture data from participants outside of the laboratory is ecological momentary assessment (EMA) via smartphones. EMA techniques allow researchers to send questionnaires or other measurement instruments directly to participants' smartphones as those participants go about their daily lives.

Although several studies have measured daily alcohol expectancies using internet web pages accessed through a computer and IVR techniques, two known studies (Benitez & Goldman, 2017; Monk & Heim, 2014) have used EMA via smartphones to track changes in alcohol expectancies. This technique may be considered the least invasive to participants' daily lives since they do not have to relocate to a desktop computer or make a phone call. Participants can simply provide responses on their smartphone wherever they are (as long as their smartphone can access the internet from their location).

Using the alcohol expectancy associate and EMA techniques just described, Benitez and Goldman (2017) showed that alcohol expectancies could be monitored as they activated in real-time and that they changed over the course of a day as individuals became closer to an actual drinking opportunity. In this study, alcohol expectancies were measured every three hours from 10 AM to 1 AM (the following morning) on a Tuesday, Friday, and Saturday (days were chosen in an attempt to gather alcohol expectancies data on at least one drinking and one non-drinking day for each individual) to examine whether alcohol expectancies changed before drinking on drinking days. A within-persons analysis indicated that alcohol expectancies increased significantly across time before drinking occurred on drinking days (i.e., Fridays and/or Saturdays), whereas they stayed relatively neutral on non-drinking days (i.e., Tuesdays).

Additionally, within-person alcohol expectancy associates measured three hours after previous measurements had test-retest reliability of 0.28 ($r = 0.28, p < .05$). The same data also showed that 42% of the variance of alcohol expectancy associates was due to between-person differences and 58% was due to within-person differences. Taken together, this measurement approach appeared to be sufficiently temporally stable and sensitive to contextual changes, making it useful for collecting alcohol expectancy associate data as it fluctuates within a day. Not only did the alcohol expectancies increase as drinking opportunities became more proximal on drinking days (possibly representing increasing motivation to drink alcohol), the timepoint most proximal to the drinking opportunity was predictive of the choice to drink alcohol, which provided evidence of tighter temporal linkage than previous studies.

Beyond the established correlational relationship between alcohol expectancies and drinking behaviors, the similar temporal and contextual patterning, and the relatively close temporal linkages, demonstrations of experimental control over drinking behaviors through the manipulation of alcohol expectancies have provided even stronger evidence that anticipatory processes are inextricably linked to drinking behaviors. To that end, numerous experiments have found that experimentally decreasing positive alcohol expectancies decreased drinking levels in the following weeks (e.g., Darkes & Goldman, 1993; Lau-Barraco & Dunn, 2008; Scott-Sheldon, Terry, Carey, Garey, & Carey, 2012; Wiers & Kummeling, 2004). These exhibited changes in drinking behaviors through the experimental control of alcohol expectancies support the theory that alcohol expectancies are a part of the motivational processes that lead to drinking.

In sum, the available literature has shown a close association between expectancy activation and alcohol consumption over a wide temporal scale and across alcohol-related situations. Furthermore, efforts to manipulate expectancies in both laboratory and real-world contexts have resulted in drinking changes. What has yet to be shown is that manipulation of drinking context results in subsequent changes to expectancies (as motivational indicators) measured in real-time using EMA techniques.

The Present Study

To further test the theory that variations in alcohol expectancies reflect changes in the motivational processes that lead to drinking, we conducted a follow-up study to Benitez & Goldman (2019). Because the Benitez & Goldman (2019) study showed variations in expectancy associates over the time period that preceded drinking in the natural environment (measured using EMA), such variations could have been a byproduct of "third variables" (weekly oscillations and/or social situations). In the present study, we mitigated third variable confounds by directly manipulating the activation of expectancies.

Differential activation of expectancies between groups of participants was attained by informing one group that they would be drinking alcohol in a bar setting while informing another group that they would be drinking soft drinks in an office setting. Weekly cycles in affect (Treloar, Piasecki, McCarthy, Sher, & Heath, 2015) and alcohol expectancies (Armeli et al., 2005; Lee et al., 2018) were controlled for by providing anticipated drinking experiences on Mondays, Tuesdays, and Wednesdays, which tend to be non-drinking days for college-aged drinkers (Del Boca et al., 2004; Finlay et al., 2012; Maggs et al., 2011; Reich et al., 2015). Social situations were controlled for by providing solitary taste-tests in the laboratory under the context of gathering college student beverage preferences.

Based on the findings of Benitez and Goldman (2017), we hypothesized that the alcohol expectancies of the group anticipating drinking alcohol would increase over timepoints as the drinking opportunities became more proximal while the alcohol expectancies of the group anticipating drinking soft drinks would stay relatively neutral over the equivalent time period. Detection of increasing alcohol expectancies before an opportunity to drink alcohol as compared to an opportunity to drink soft drinks (on a day of the week that is not usually a drinking day) would be an indication that the motivational processes were ramping up in anticipation of drinking alcohol and not to weekly cycles, leading us to make a stronger inference that alcohol expectancies are a part of the motivational processes that lead to drinking. In addition to the main research question, the present study was also designed to explore the relationship between alcohol expectancies and the amount of "beer" (participants drank non-alcoholic beer; see methods below) that participants consumed in the experimental condition.

Unfortunately, due to historical health concerns about the spread of corona virus disease 2019 (COVID-19), data collection had to be prematurely discontinued. Although a majority of the data collection planned for this study was obtained prior to the premature discontinuation, the final sample size was lower than what had been deemed necessary by an a priori power analysis to make reliable conclusions. We approached the reporting of the results of this study, therefore, as an opportunity to apply the logic of the experimental design to extract some useful information about the utility of this line of research despite the shortfall in the number of participants. To this end, we extensively examined data patterns within graphical representations as an aid to analysis. After thorough examination of the data patterns, we then applied the originally proposed statistical modeling procedures, knowing that these findings were unlikely to be significant given the absence of sufficient statistical power. It was hoped that this thorough examination of the data, using both data patterns and statistical analysis, would be helpful in extracting useful information for future research.

Method

General Design

The present study, as originally designed, combined EMA techniques with in-laboratory experimentation. Students signed up through Sona Systems to come into the laboratory on a Monday, Tuesday, or Wednesday between 5:00 PM and 6:00 PM to taste and rate alcohol or soft drinks. Participants were randomly assigned to one of two groups: a) the alcohol group (experimental condition) or b) the soft drink group (control condition). The evening before they were scheduled to participate, participants received a text message on their cell phones with a link to a page that revealed whether they would be tasting and rating alcohol or soft drinks the following day in the laboratory. This webpage also contained a relevant picture to help build anticipation. A bar scene with people drinking beer was presented to the alcohol group and an office scene with people drinking soft drinks was presented to the soft drink group. Beginning at 9:30 AM on their scheduled participation day, participants were sent text messages every two hours (i.e., 9:30 AM, 11:30 PM, 1:30 PM, and 3:30 PM) with a link to a short survey. Each survey link was active for 30 minutes. All surveys were identical and included measures of alcohol expectancies, affect, and soft drink expectancies.

Upon arrival to the laboratory, participants were asked to orally respond to eligibility questions about possible pregnancy, alcohol allergies, and age (participants showed a valid government-issued form of identification to prove age). After participants proved their eligibility for the study and gave their consent for the in-laboratory portion of the study, they were escorted by a research assistant to one of two rooms containing different scenarios that correspond with experimental condition. Participants in the alcohol group entered into a bar scenario (room with lots of alcohol stimuli) to rate two different "beers" (non-alcoholic beers) on the look, smell, and taste. Participants in the soft drink group entered an office scenario (room with no alcohol stimuli) to rate two different soft drinks on the look, smell, and taste. Following the taste-rating task, participants completed a questionnaire collecting data on drinker type, how much they like drinking beer, near-term drinking intentions, and demographics before being debriefed (see Figure 1).

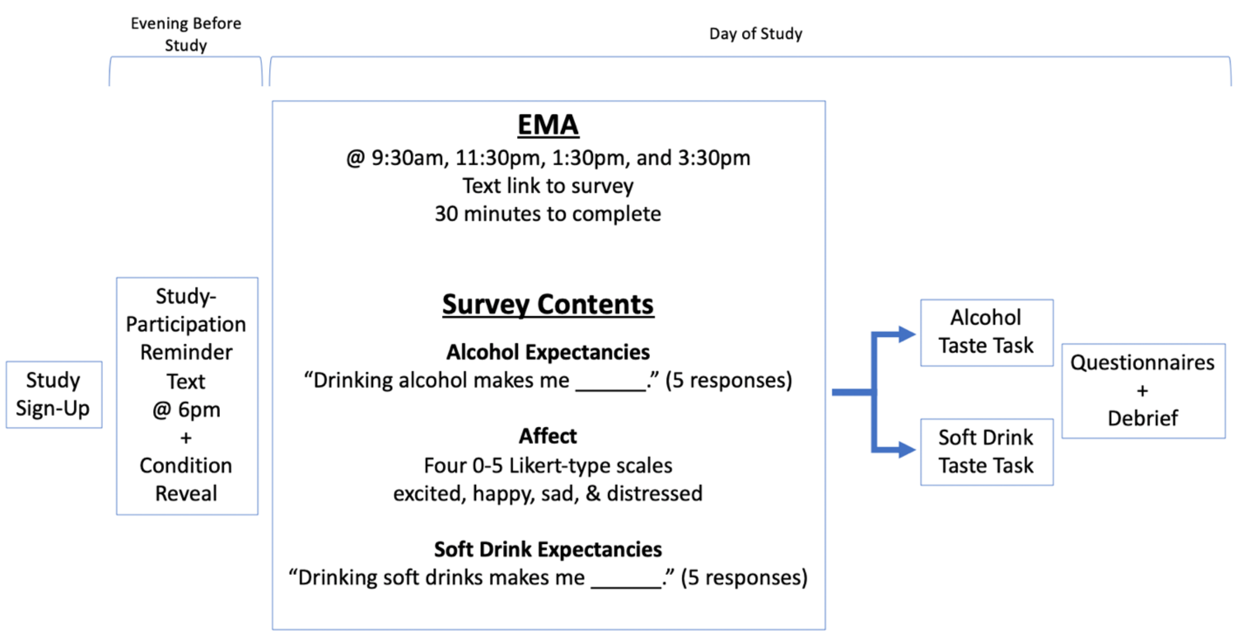

Figure 1. *Study Design*

Participants

Out of the proposed 140 participants to be run for this experiment, 109 participants completed the protocol before the experiment was prematurely concluded to help slow the spread of COVID-19. All participants were undergraduate college students recruited from the Sona Systems participant pool at the University of South Florida. They were all at least 21 years old, reported no allergy to alcohol or ingredients in common alcoholic beverages, had no reason to suspect that they were pregnant, and reported drinking at least once in the past 30 days. All participants had a smartphone to receive messages and respond to questionnaires.

Measures

Alcohol Expectancies

Participants' alcohol expectancies were measured using alcohol expectancy associates, whereby participants were instructed to "Fill in the blanks with the first word that you think of. Answer as fast as you can. Alcohol makes me __________." Participants were asked to provide five responses at each timepoint. The associates were quantified using two scoring methods. First, each alcohol expectancy associate was given a salience score based on Smith's *S* index (Smith, 1993; Sutrop, 2001; Thompson & Juan, 2006). This salience score was intended to give more statistical weight to associates that were provided earlier on each list of five associates that participants provided, as the order of retrieval reflects the immediacy of the associates to the given contextual circumstances (Nelson, McEvoy, & Dennis, 2000). Salience scores range from 0 to 1 with 0 indicating that the associate was not on the list and 1 indicating that the associate was first on the list. The salience score was calculated by taking the total number of associates provided by an individual at a given time point, subtracting the position/rank of the associate, adding 1, and dividing the resultant number by the total number of associates provided at a given time point. For example, if an individual provided five associate responses, the first associate would have a salience score of 1 ([5 – 1 + 1] / 5 = 1.0), the second associate would have a salience score of 0.8 ([5 – 2 + 1] / 5 = 0.8), the third associate would have a salience score of 0.6 ([5 – 3 + 1] / 5 = 0.6), etc. Second, each associate was given a valence rating. These ratings were obtained from a database that was the result of a longitudinal study in which participants completed an alcohol expectancy associate measure numerous times over 5 years (see Reich et al., 2015). Participants in the study were asked to rate each of their associates on pleasantness (i.e., valence) on a 1-7 scale, with higher scores representing a higher pleasantness rating. Mean pleasantness ratings for each alcohol expectancy associate across the longitudinal study were used as the valence score for each alcohol expectancy associate response in the present study. Salience and valence scores were then multiplied to create a salience-valence score for each provided associate.

Soft Drink Expectancies

Participants' soft drink expectancies were measured using soft drink expectancy associates. Participants were instructed to "Fill in the blanks with the first word that you think of. Answer as fast as you can. Soft drinks make me _________." This measure was used to support the cover story of wanting to know more about participants' beverage preferences. Responses to this measure were not analyzed.

Affect

Previous research found that positive affect increased before drinking and negative affect decreased before drinking (Treloar et al., 2015). To control for affect in the analyses, state affect was collected in a manner similar to Treloar et al. (2015). Participants rated how "excited," "happy," "sad," and "distressed" they currently felt on a scale that ranged from 0 ("not at all") to 5 ("extremely"). Positive affect scores were calculated by averaging the responses to "excited" and "happy" and negative affect scores were calculated by averaging the responses to "sad" and "distressed." Total affect was calculated by multiplying all negative affect scores (i.e., responses to "sad" and "distressed") by -1 and averaging the responses of all four scales.

Taste-Rating Task

Alcohol consumption was measured using the widely used taste-rating task (Marlatt et al., 1973). To minimize the risk to participants, specifically to women who may have been unknowingly pregnant, non-alcoholic beers were used, which previous research has shown to be an acceptable proxy for actual alcohol-containing beers (Carter, McNair, Corbin, & Black, 1998; Roehrich & Goldman, 1995; Tan & Goldman, 2015). Participants were escorted into a bar laboratory setting and presented with two carafes, labeled "A" and "B," and two empty glasses, also labeled "A" and "B." The two carafes contained 355 milliliters of two different non-alcoholic beers. Participants were instructed to drink as much as they wanted to provide informed ratings. Participants were given 10 minutes to drink while they rated the beers on several variables, including look, smell, and taste. Liquid volume measurements (in milliliters) were taken to calculate the volume of alcohol poured from the carafes and the volume of alcohol consumed.

Drinker Type

Participants were asked, "On average, how often do you consume alcoholic beverages of any kind? (Note: Each 'time' or drinking occasion must be separated by a period during which you become completely sober again.)" Participants had 10 response options ranging from "Once a month or less" to "21 or more times a week." Participants were also asked "On average, how many 'drinks' do you have each 'time' or on each occasion when you do consume alcoholic beverages? (Note: one 'drink' = one 12-ounce beer or one 5-ounce glass of wine or one 1.5-ounce shot of hard liquor, straight or with mixer.)" Participants had 10 response options ranging from "Less than one whole drink" to "More than 12 'drinks.'" Female participants who indicated that they drink 4 or more drinks per drinking occasion and male participants who indicated that they drink 5 or more drinks per drinking occasion were considered "binge drinkers."

Beer Preference

Participants were asked to respond to the item, "How much do you like drinking beer?" on a 1-10 scale, with 1 representing "Not at all" and 10 representing "Extremely."

Near-Term Drinking Intentions

Following the experiment, participants were asked "Have you consumed any alcohol today," "Did you consume any alcohol last night," and "Before coming in today, did you have any plans to consume alcohol after participating in this study?" Near-term drinking intentions were used as a manipulation check. The EMA responses of participants who responded "yes" to either of these questions may have been influenced by drinking opportunities outside the experimental conditions. For example, participants in the soft drinks condition who responded "yes" to either question would have provided EMA data that reflected a drinking day, as opposed to the non-drinking day that their experimental condition required.

Manipulation Checks

When participants entered the laboratory at their scheduled appointment time, they were asked which beverage they were assigned to test. Accurate responses of "alcohol" and "soft drinks" were considered an indication that the manipulation the previous evening worked. Inaccurate responses suggested that the manipulation may not have worked. Analyses were performed with and without the data from those participants.

For the taste-test portion of the study, participants were asked to guess the alcohol content of the beer they drank to probe their belief of whether they were drinking alcoholic beverages. Participant responses greater than 0% were considered an indication that participants believed they were drinking real beer.

Demographics

General demographic information (age, gender, and race/ethnicity) was collected following all other questions to avoid influencing the experiment.

Procedure

Participants signed up for a specific time slot of the study through Sona Systems. The available time slots were every 15 minutes beginning at 5:00 PM and ending with 6:00 PM on Monday, Tuesday, and Wednesday. Only one participant was allowed to sign up for each timeslot. Upon signing up for the study, participants were required to enter the smartphone number that they would use for the study. Participants were then advanced to a confirmation page informing them that they would receive a text message the evening before their participation date. The purpose of the text message was to remind them of their scheduled participation time and inform them of whether they would be testing alcohol or soft drinks the following day. The confirmation email also reminded them of the eligibility requirements of the study (i.e., at least 21 years old, have no allergy to alcohol, and not be pregnant) and that on their scheduled participation day they would be expected to respond to short questionnaires every two hours until their scheduled study participation time.

At 9:30 AM the morning of their scheduled participation day, participants received the first of four text messages via Qualtrics mailer. The text messages contained a link to the survey questions and informed the participants that the link would be active for 30 minutes. Participants provided responses to the alcohol expectancy associates prompt, the four state affect items, and the soft drink expectancy associates prompt. This process was repeated at 11:30 PM, 1:30 PM, 3:30 PM. Upon arrival at the laboratory, participants were required to orally respond to eligibility questions, including items about possible pregnancy ("Do you have any reason to suspect that you are pregnant?"), possible alcohol allergy ("Are you allergic to any ingredients found in common alcohol-containing beverages?"), and age (participants will have to provide a valid, government-issued form of identification to verify that they are at least 21 years old).

Once participants proved their eligibility and consented to participate in the in-laboratory portion of the study, they were escorted by a research assistant to one of two rooms. Participants in the alcohol group were escorted to a bar laboratory (i.e., a room with a bar and barstools, tables and chairs, and alcohol stimuli on all of the walls, such as bottles filled with liquid mimicking alcohol and alcohol signs and advertisements) and participants in the soft drink group were escorted to an office-like room (i.e., a room with shelves full of books and filing cabinets). The rooms had either a bar stool at a bar or a chair at a table (alcohol and soft drinks conditions, respectively) with two carafes, each with 12 ounces of a different beer (or soft drink) labeled "A" and "B." Two corresponding glasses marked "A" and "B," a small glass of water, as well as the taste-task questionnaire on which participants will rate the look, smell, and taste of each drink were available. Participants were instructed by the research assistant to pour the drinks into the corresponding glasses and taste as much as they would like to provide their most accurate ratings. The research assistant left the participant in the room for 10 minutes with a check-in after 5 minutes. Following the taste-rating task, the volume of alcohol poured from the carafe and the volume of alcohol consumed were calculated using graduated cylinders. Following the taste-rating task, participants completed questionnaires that include items for near-term drinking intentions, drinker type, how much they like drinking beer, manipulation check, and demographics. Participants were debriefed following the completion of this questionnaire.

Results

Due to historical health concerns about the spread of COVID-19, data collection was prematurely discontinued after collecting a sample of 109 participants. Based on the results of an a priori power analysis, a sample of 140 participants had been deemed necessary to detect a medium effect size (d = .5) with power of 0.8 for our main hypothesis. Given the absence of the predetermined sample, and a post hoc power analysis indicating an achieved effect size of .28 (performed as described by Feingold [2009] for a repeated measures design in which the potency of the intervention was the main interest) for the between-group effect of all expectancy scores averaged across timepoints, we could not be confident that the data patterns were sufficiently reliable to allow for statistically justified conclusions about group differences between the two study conditions. We were able, however, to examine the available data for patterns that might be suggestive of how well the results conformed to our original hypotheses. The purposes of these examinations were to understand whether there were any signs of the hypothesized effect, decide on whether this line of research was viable for future efforts, and to better understand the quality of our experimental design.

Data Exclusion

To experimentally test whether expectations of drinking alcohol or soft drinks later in the day had a differential effect on reported alcohol expectancies, those expectations had to be manipulated. Participants were informed/primed at 6 PM the night before their scheduled participation day of whether they would be drinking alcohol or soft drinks when they came into the laboratory. As a manipulation check, when participants entered the laboratory at their scheduled participation time, a research assistant asked them if they knew which type of beverage they would be testing. Of the 109 participants who completed the protocol, 16 participants reported not knowing which type of beverage they were assigned to test. Because such reports might indicate that those 16 participants had not, with certainty, engaged in the required task (a necessary boundary condition for the experiment), we initially carried out the analyses after excluding this data.

Demographics

Of the participants whose data were left for analysis (*N* = 93), 65.6% of them were white, 13% were black, and no other racial group represented more than 10% of the sample. Participants were 23.4 years old (*SD* = 4.1) on average and 69.9% of them were female. Race, gender, and age did not differ by condition (See Table 1).

Although the 2:1 female to male ratio and the age range was expected based on other studies that sampled from the same population, the racial imbalance was not expected. USF tends to have a more racially diverse undergraduate population than what was represented in our sample. That said, this mostly female and mostly white sample of undergraduate college students limited the generalizability of the trends we observed in this sample.

Compliance

Review articles have indicated that published EMA studies tend to have compliance rates of 50-90% (Shiffman, 2009; Shiffman et al., 2008). Participants in the current study provided responses for 86.4% of the timepoints during the EMA portion of the experiment, which was near the upper end of reported EMA compliance rates. Additionally, all participants provided all five responses at each timepoint to which they responded, and a chi-square test of independence indicated compliance rates across timepoints was not significantly different between conditions, X^2 (3, N = 93) = 0.12, p = 1.000 (See Table 2). The data was treated, therefore, as missing at random.

Table 1. *Demographic Characteristics of All Participants Who Knew Their Condition*

	Alcohol		Soft Drinks		Total	
	n	%	*n*	%	*n*	%
Gender						
Female	31	64.6	34	75.6	65	69.9
Male	17	35.4	11	24.4	28	30.1
Race						
Asian or Asian-American	3	6.3	2	4.4	5	5.4
Black /African-American	6	12.5	6	13.3	12	12.9
Hispanic/Latino	2	4.2	3	6.7	5	5.4
Multi-Racial	5	10.4	2	4.4	7	7.5
Other	1	2.1	2	4.4	3	3.2
White	31	64.5	30	66.7	61	65.6

Note. N = 93 (Alcohol group, n = 48; Soft Drinks group, n = 45). Participants were on average 23.4 years old (SD = 4.1).

Table 2. *Compliance Rates Across Timepoint Condition*

	Alcohol		Soft Drinks		Total	
	n	%	*n*	%	*n*	%
Overall	149	77.6	155	86.1	304	86.4
Timepoint						
9:30 AM	37	77.1	39	86.7	76	81.7
11:30 AM	36	75.0	39	86.7	75	80.6
1:30 PM	37	77.1	36	80.0	73	78.5
3:30 PM	39	81.3	41	91.1	80	86.0

Means

Knowing that the results of the proposed inferential analyses would be underpowered due to the truncated sample size and a lower achieved effect size than what was used in the a priori power analysis, we turned to the graphing of means to examine the influence of the experimental manipulation. Our main research question was focused on how alcohol expectancies collected at several timepoints in a day would be differentially related to the expectation of drinking alcohol versus soft drinks later in the day. To examine this data, mean salience-valence scores of alcohol expectancy associates were plotted by timepoint as a function of condition (See Figure 2).

The graph showed an overall negative trend across time, no signs of an interaction effect between time and condition, and the possibility of a main effect of condition, such that the participants in the alcohol condition responded with higher-valenced alcohol associates than the soft drink condition on average. Although the predicted interaction effect was not visually apparent, the differences in alcohol expectancies between conditions was in the predicted direction—the alcohol expectancies provided by participants in the alcohol condition were more positive on average than those provided by participants in the soft drinks condition. These differences in alcohol expectancies between conditions suggested that expectations of drinking alcohol (versus soft drinks) later in the day might have had an effect on participants and, in turn, on the alcohol expectancy associates they provided. The relatively large standard error associated with each mean in this truncated dataset left open the possibility that this pattern was unreliable and would not repeat in future studies of this kind.

The negative trend in alcohol expectancies observed across time in Figure 2 was inconsistent with the findings of Benitez and Goldman (2019) who observed alcohol expectancies rising on drinking days and staying relatively neutral on non-drinking days. One

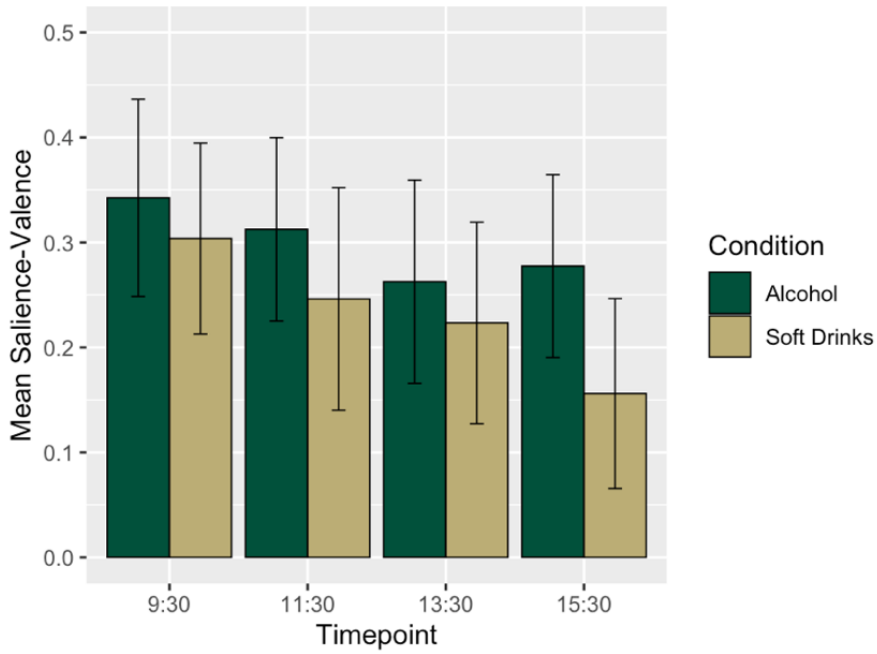

Figure 2. *Mean Salience-Valence Across Time by Condition*

possible explanation was that this inconsistency was due to differences between the real-world drinking opportunities experienced by the participants in Benitez and Goldman (2019) versus the in-laboratory drinking opportunities experienced by the participants in the current experiment. Having primed participants at 6 PM the prior evening with a drinking opportunity, participants in the current experiment could have responded to the 9:30 AM assessment with their more general alcohol associations related to their typical drinking experiences. Then as the drinking opportunity became more proximal, the differences between this taste-test drinking opportunity for an experiment and typical real-world drinking opportunities could have become more apparent, resulting in lower valenced alcohol associates across time. This dynamic story, however, did not explain the overall negative trend of the soft drinks group.

We then considered gender as a source of variation that may have led to error patterns in these means due to known gender differences in alcohol consumption quantities (i.e., men tend to have higher rates of alcohol use than women; Keyes, Li, & Hasin, 2011) and beverage preferences (e.g., men prefer beer more than women; Statista, 2020). To examine the data, overall mean salience-valence scores were separately graphed condition as functions of gender (See Figure 3). The graphs showed a negative trend over time in mean salience-valence scores for men in both conditions and for women in the soft drinks condition, while the trend for the women in the alcohol condition was relatively neutral throughout the day. These differences might have been due to the unreliability of the data or an indication of gender-based differential effects of the experimental manipulation.

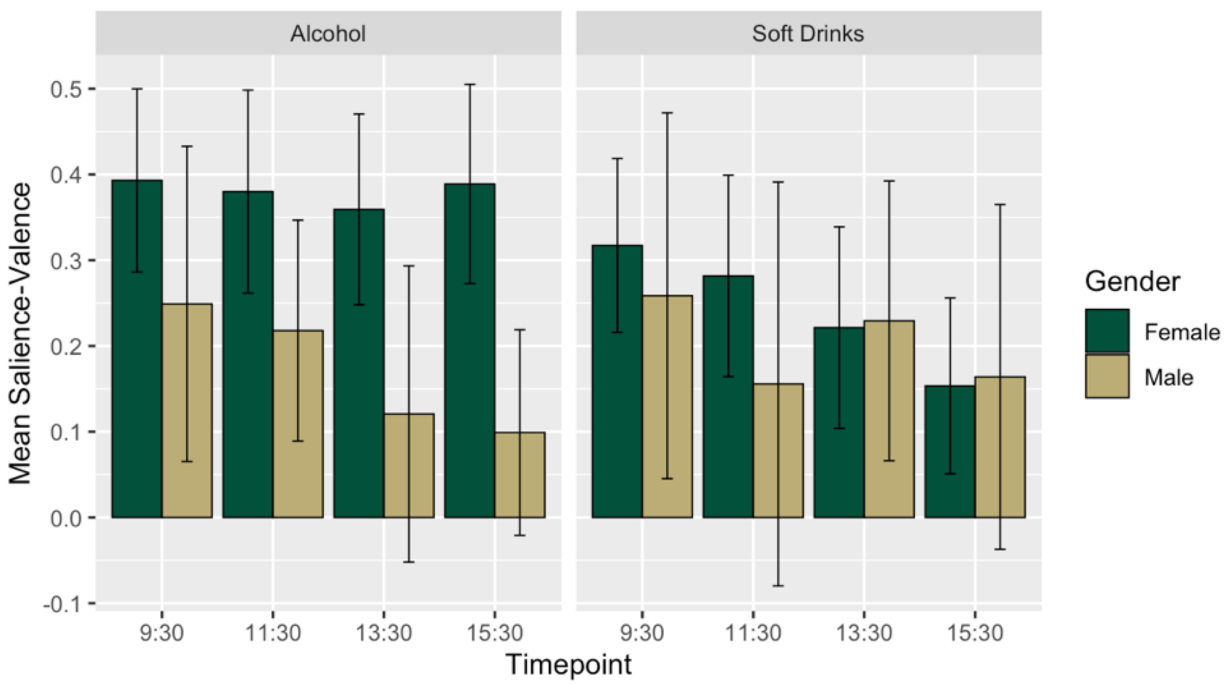

Figure 3. *Mean Salience-Valence Across Time by Gender, Graphed by Condition*

Inferential Analyses

Although trends in the data suggested that the anticipation of drinking alcohol or soft drinks later in the day may have affected participants, and in turn the alcohol expectancy associates they provided, the trends were observed in the raw mean data and did not account for the effects of known covariates such as gender, drinker type, and affect. Using multilevel modeling to account for the nested/dependent data by simultaneously analyzing the between groups and across timepoints variations (Curran & Bauer, 2011; Hertzog & Nesselroade, 2003), we were able to examine whether the raw mean trends were maintained beyond the effects of the known covariates. The multilevel models were constructed beginning with the unconditional model and increased in complexity until the final (proposed) model was reached. Although the traditional purpose of inferential statistical analysis is to test the reliability of observed differences in data, the truncated dataset of the current experiment lacked statistical power and therefore, statistical reliability. The purpose of the multilevel modeling, therefore, was to create a visual representation (i.e., a graph) of the final model that would allow us to visually examine the relationship between what participants anticipated drinking (i.e., alcohol or soft drinks) and their alcohol expectancies while controlling for the known covariates. The following is a description of the multilevel modeling.

An unconditional model (model 1) was constructed to determine the ICC, which would reveal the amount of variance in the data due to between-person differences (trait characteristics) and within-person differences (state characteristics). The presence of substantial within-person variability would indicate that the data was nested and support the use of multilevel modeling. The ICC indicated that 52.8% of the variance was accounted for by between-person factors and 47.2% of the variance was accounted for by within-person factors. With nearly half of the variability accounted for by within-person factors, the alcohol expectancy measurements were sufficiently sensitive to both between- and within-person factors and supported the use of multilevel modeling.

Model 2 was a 2-level model that included time (level 1) as a continuous variable. This model indicated whether alcohol expectancies changed over time and, if they did, the shape of that change (i.e., linear or quadratic). To develop model 2, time was tested as a random- and fixed-effects predictor in linear and quadratic equations (four equations). All equations were individually compared to model 1 using likelihood ratio tests (maximum likelihood). The best fitting model (i.e., model with the lowest Akaike Information Criterion [AIC]) was the linear model with time as a fixed effect and was used as model 2. Consistent with observed means in the previous graphs, the estimate for time indicated that alcohol expectancies slightly decreased across time; however, the change was not statistically significant ($\pi_1 = -0.02$, $p < .118$).

For model 3, condition was added as a level-2, fixed-effect predictor to examine the effect of condition on alcohol expectancies while controlling for time. As expected given the truncated dataset, the estimate for condition was not significant ($\pi_2 = -0.06$, $p < .571$) and indicated that alcohol expectancies were not statistically different between conditions when controlling for time-of-day. Model 4 was then constructed to examine the effect of condition on alcohol expectancies while controlling for known covariates (i.e., gender, affect, and drinker-type as defined as "binge drinker" or "non-binge drinker"). Once again, as expected, the results indicated that condition was not predictive of alcohol expectancies while controlling for known covariates ($\pi_2 = -0.07$, $p < .516$).

Model 5, the final model, was constructed as an examination of our hypothesis that alcohol expectancies would change differently over time as a function of condition while controlling for gender, drinker-type, and affect (equation below). More specifically, model 5 was constructed to create a graphical representation of the data and allow for visual examination of whether alcohol expectancies from participants in the alcohol condition increased over time as compared to those from participants in the soft drinks condition, which would stay relatively neutral over time. To construct model 5, a cross-level interaction effect between time (level 1) and condition (level 2) was added to model 4. As expected, the results of the statistical analysis indicated that the time-by-condition interaction effect on alcohol expectancies was not statistically significant while controlling for gender, drinker-type, and affect. Additionally, no predictors in model 5 had a significant effect on alcohol expectancies (See Table 3 for model 5 parameter estimates). The graph (See Figure 4), however, showed that while statistically controlling for gender, drinker-type, and affect, alcohol expectancies from the participants who anticipated drinking alcohol were more positive at each timepoint and declined at a slower rate than the alcohol expectancies from the participants who anticipated drinking soft drinks. This trend suggested that the anticipation of drinking alcohol later in the day affected participants and led them to provide more positive alcohol expectancy associates as compared to the control condition. With the knowledge that the differences observed in the graph were not statistically reliable, more convergent evidence was needed to support the idea that the anticipation of drinking alcohol or soft drinks differentially affected alcohol expectancies.

$$\text{Salience-Valence}_{ti} = \pi_{0i} + \pi_{ti}\text{Time}_{ti} + e_{ti}$$

$$\pi_{0i} = \beta_{00} + \beta_{01}\text{Condition}_i + \beta_{02}\text{Gender}_i + \beta_{03}\text{Drinker-Type}_i + \beta_{04}\text{Affect}_i + r_{0i}$$

$$\pi_{1i} = \beta_{10} + \beta_{11}\text{Condition}_i$$

Removing Participants who Drank or Planned to Drink

Participants who reported drinking before coming into the laboratory (n = 4), planning to drink following their participation (n = 10), or drinking before and planning to drink following their participation (n = 1), may have responded to the measures while outside the experimental

Table 3. *Multilevel Model of Time-of-Day, Condition, Gender, Drinker-Type, Affect, and Condition*Time-of-Day predicting Mean Salience-Valence Scores*

Parameters	Parameter Estimates
Fixed Effects Predictors	
Intercept (β_{00})	0.35 (0.13)
Time of Day (π_1)	-0.01 (0.01)
Condition (π_2)	-0.04 (0.12)
Gender (π_3)	-0.12 (0.11)
Drinker Type (π_4)	0.05 (0.11)
Affect (π_5)	-0.01 (0.04)
Condition*Time (π_6)	-0.01 (0.02)
Variance Estimates	
Level-1 variance (σ^2)	0.16 (0.39)
Level-2 intercept variance (τ_{00})	0.17 (0.42)

Note. Empirical standard errors (SE) in parentheses following predictor parameter estimates. Standard deviations (SD) in parentheses following variance estimates. Time-of-day was centered on the first assessment time point of the day (i.e., 9:30 AM). Expectancies and affect scales were centered so that positive/negative scores reflect positive/negative expectancies/affect. No estimates were significant.

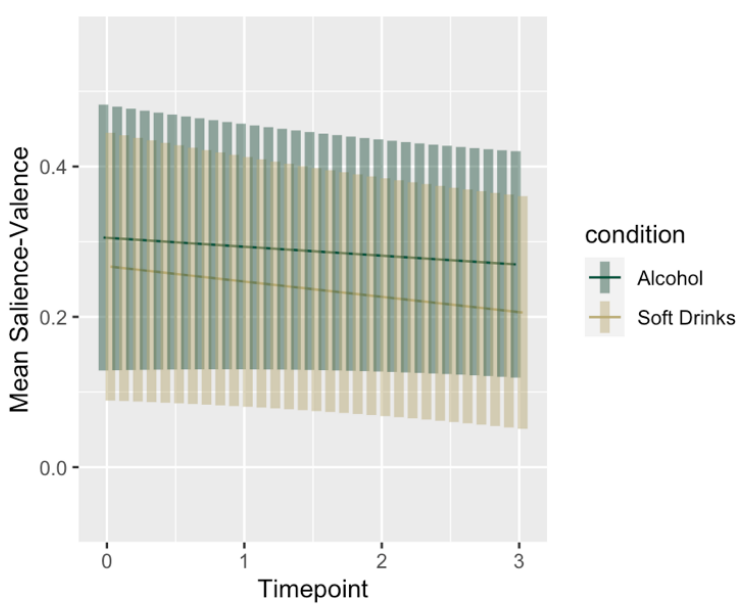

Figure 4. *Changes in Mean Salience-Valence as a Function of Condition and Time*
Note. Added bars are confidence intervals.

boundaries. That is, it was possible that our manipulation had the predicted effect, and that additional effects became manifest in drinking circumstances outside the laboratory. For example, participants in the soft drinks condition who reported drinking before or planning to drink after their participation might not have been responding to the measures as if it was a non-drinking day. Additionally, because young adults tend to drink in social environments, participants in the alcohol condition who reported drinking before or planning to drink after participation might have been responding to the measures as if their drinking opportunities were associated with social drinking events. For these reasons, additional examinations were performed with their data removed.

Of the 15 participants who drank before coming into the laboratory and/or planned to drink following their participation, 10 of them were female and five of them were male. This 2:1 ratio of women to men was consistent with the overall gender ratio within this sample. The number of participants removed from each of the conditions, however, was not equal; four of them were from the alcohol condition and 11 of them were from the soft drinks condition (See Table 4). Mean alcohol expectancy associate salience-valence scores of all participants who knew their condition, did not drink before, and did not plan to drink following participation were then plotted across timepoints by condition (See Figure 5). Consistent with Figure 3, the graph showed that participants in the alcohol condition consistently provided more positive alcohol associates across timepoints than participants in the soft drinks condition.

We then used multilevel modeling to construct a graph that showed how alcohol expectancies changed by condition over time while statistically controlling for gender, affect, and drinker-type. Consistent with Figure 4, the graph showed that participants in the alcohol condition consistently provided more positive alcohol associates across timepoints than

Table 4. *Frequency of Participants Who Knew Their Condition and Drank Before or Planned to Drink After Participation by Condition and Gender*

	Alcohol	Soft Drinks	Total
	n	*n*	*n*
Female	1	9	10
Male	3	2	5

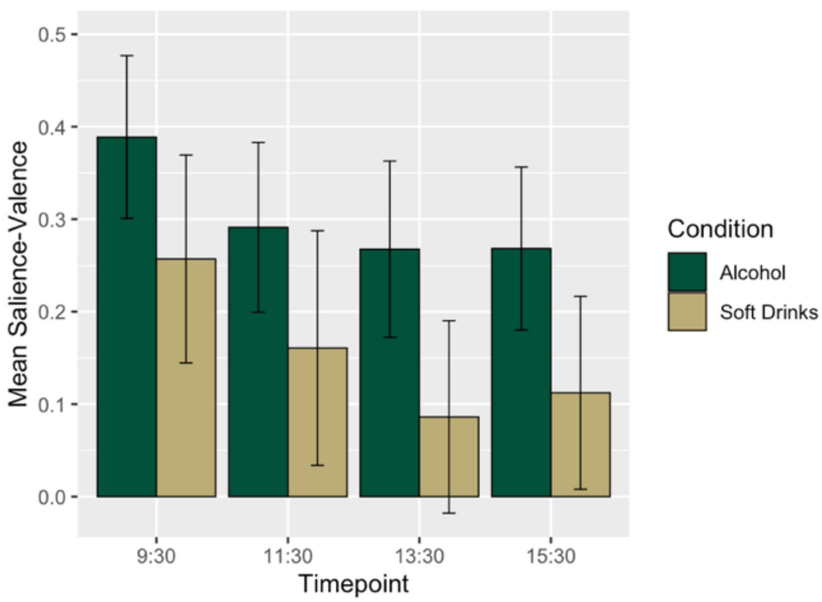

Figure 5. *Mean Salience-Valence of Participants Who Did Not Drink Before or Plan to Drink Following Participation Across Time by Condition*

participants in the soft drinks condition while controlling for gender, affect, and drinker-type (See Figure 6). Additionally, there was a trending cross-level interaction between time and condition, such that the alcohol expectancies from the participants in the alcohol group declined at a slower rate than the alcohol expectancies from the participants in the soft drinks group. When examining the graph in comparison to Figure 4, which included the participants who drank before or planned to drink after participation, the observed differences in alcohol expectancies between the two conditions were noticeably larger. Although, as expected, the differences between conditions were not statistically significant, the resulting decrease alcohol expectancies in the soft drinks condition (and therefore the increase in differences between the two conditions) was consistent with our theory that alcohol expectancies would be more positive from participants who anticipated drinking alcohol later in the day.

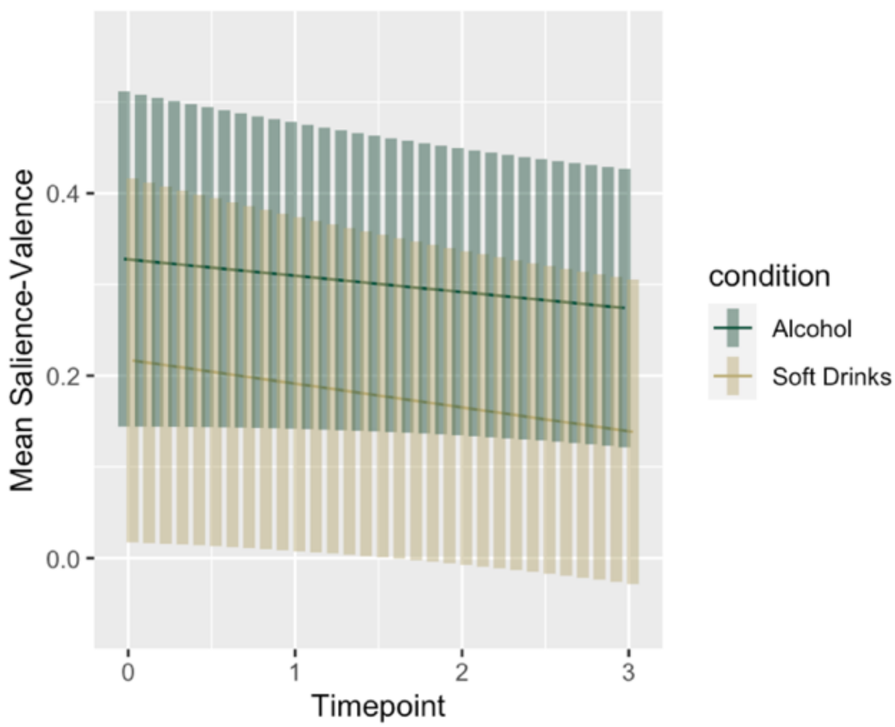

Figure 6. *Changes in Mean Salience-Valence of Participants Who Did Not Drink Before or Plan to Drink Following Participation as a Function of Condition and Time*
Note. Added bars are confidence intervals.

Alcohol Taste-Test Consumption Analyses

The current experiment was designed to investigate whether the priming/activation of anticipatory processes related to drinking alcohol would affect alcohol expectancies in a way consistent with our theory that more positive alcohol expectancies are an indication of a higher motivation to drink alcohol. The main hypothesis of the study necessitated priming participants' expectations of the type of beverages they would be drinking and measuring alcohol expectancies throughout the day leading to the expected drinking opportunity. A taste-test drinking opportunity was then provided to support the cover story (of researching college students' beverage preferences) and for the opportunity to explore how alcohol expectancies related to actual drinking behaviors. If alcohol expectancies were sufficiently activated by the experimental manipulation, and if alcohol expectancy activation becomes manifest in actual drinking behavior as our theory suggests, then we should have observed drinking consistent with participants' alcohol expectancies. To this end, we examined the relationship between participants' alcohol taste-test consumption quantity and their alcohol expectancies using only data from participants who drank alcohol in the taste-test.

We began by examining how participants' total mean alcohol expectancy scores (i.e., each participant's salience-valence scores averaged across timepoints) related to alcohol consumption quantities to compare our data with past research that found alcohol expectancies to be associated with drinking levels (e.g., Boyd, Sceeles, Tapert, Brown, & Nagel, 2018; Brown et al., 1985; Smith & Goldman, 1994). A correlational analysis indicated they were not significantly correlated, $r(46) = -.21$, $p = .152$ (See Figure 7), which was inconsistent with past research findings. We then examined how participants' alcohol consumption quantities were related to their alcohol expectancy scores at the final timepoint (i.e., 3:30 PM) to compare our data with those from Benitez and Goldman (2019), who found that alcohol expectancies were predictive of the decision to drink within the following three hours. Again, a correlational analysis indicated that alcohol consumption and alcohol expectancy scores at the final timepoint were not significantly correlated, $r(37) = -.20$, $p = .217$ (See Figure 8), which was inconsistent with the findings of Benitez and Goldman (2019).

To examine whether alcohol expectancies were related to alcohol consumption while controlling for known covariates (i.e., gender, drinker-type, previous drinking frequency, and how much participants reported liking beer), regression analyses were performed with total mean expectancy scores as the dependent variable (See Table 5). The analysis with all considered covariates indicated that alcohol expectancies were not a significant predictor of alcohol consumption while controlling for known covariates. Gender and drinker-type, however, were significant predictors of alcohol consumption while controlling for known covariates, such that men drank more than women (*M* = 286.47 ml and *M* = 73.87 ml, respectively; See Figure 9) and binge drinkers drank more than non-binge drinkers (*M* = 211.31 ml and *M* = 126.09 ml, respectively). Comparing regression models including and excluding alcohol expectancies as a predictor revealed that there was a .004 increase in R^2 after including alcohol expectancies, indicating that alcohol expectancies had a near-zero effect on alcohol consumption while statistically controlling for gender, drinker-type, previous drinking frequency, and how much participants reported liking beer.

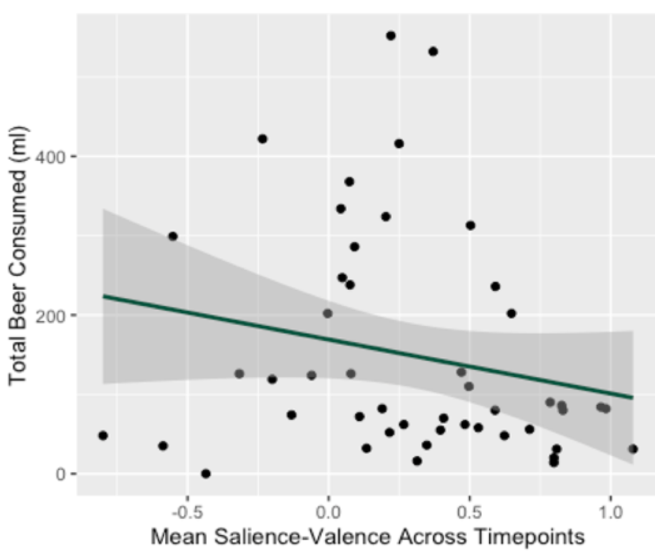

Figure 7. *Total Beer Consumed by Alcohol Expectancies Across Timepoints*
Note. Added bars are standard errors.

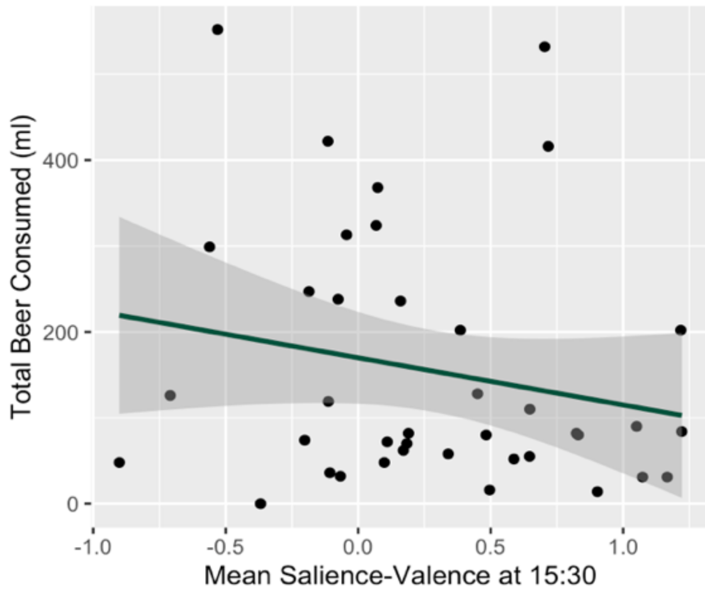

Figure 8. *Total Beer Consumed by Alcohol Expectancies at Final EMA Timepoint*
Note. Added bars are standard errors.

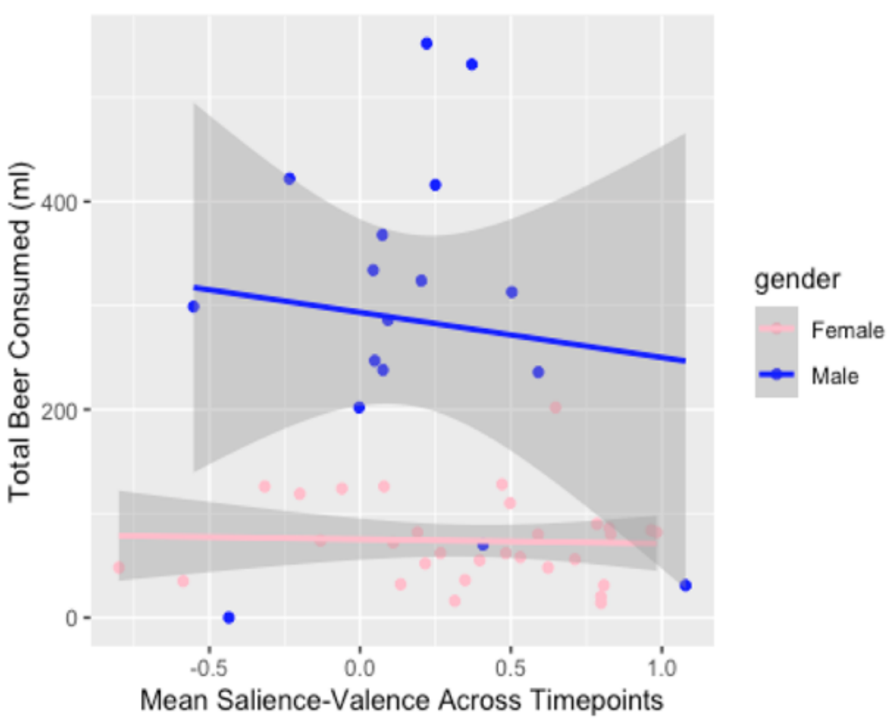

Figure 9. *Total Beer Consumed by Alcohol Expectancies Across Timepoints as a Function of Gender*
Note. Added bars are standard errors.

Table 5. *Regression Results Predicting Alcohol Consumption*

Predictor	Estimate	*SE*	95% CI	Fit	Difference
(Intercept)	101.16*	43.87	12.69, 189.64		
Gender (Male)	202.95**	30.13	142.18, 263.71		
Binge Drinker Status (Non-Binge Drinkers)	-74.97*	30.23	-135.94, -14.00		
Previous Drinking Frequency	12.97	10.77	-8.76, 34.70		
Like Beer Rating	-1.64	4.94	-11.60, 8.32		
				R^2 = .605	
(Intercept)	106.09*	44.92	15.45, 196.73		
Gender (Male)	198.07**	31.37	134.75, 261.38		
Binge Drinker Status (Non-Binge Drinkers)	-75.03*	30.46	-136.49, -13.56		
Previous Drinking Frequency	13.61	10.90	-8.39, 35.62		
Like Beer Rating	-1.46	4.99	-11.52, 8.60		
Alcohol Expectancies	-19.88	32.37	-85.19, 45.44		
				R^2 = .609	ΔR^2 = .004

Note. *b* represents unstandardized regression weights. * indicates $p < .05$. ** indicates $p < .01$.

Discussion

The current study was designed as a follow-up to Benitez and Goldman (2019), in which the associational strength of alcohol expectancies gathered using EMA techniques were shown to ramp up in anticipation of real-world drinking events. This concordance between expectancy activation and subsequent actual drinking supported the idea that expectancy activation was part of the motivational processes that led to drinking. Because Benitez & Goldman (2019) used an EMA design, which did not manipulate critical variables, however, the possibility was left open that expectancy activation was not motivating ("causing") drinking. Instead, it remained a possibility that both expectancy activation and drinking increases were due to other naturally occurring controlling variables that operated in the natural environment. Among these "third variables" were the known weekly cycle of alcohol expectancies and social drinking contexts. Although Benitez and Goldman (2019) were able to statistically account for weekly affect cycles, they were not able to account for social factors related to the drinking occasions. The current study was designed to address these potential third variables by similarly using EMA techniques to gather alcohol expectancy data in real world contexts while adding experimentally controlled, solitary drinking occasions on days of the week that were not typically drinking days (Mondays, Tuesdays, and Wednesdays).

In the current experiment, participants were assigned to conditions in which they were informed they would be drinking either alcohol or soft drinks the following day when they came into the laboratory. Unfortunately, a historical pandemic event (the spread of COVID-19) led government and university officials to shut down in-person interactions and regulate social distance before all participants could be run. At that point, data from 109 out of the prescribed 140 participants had been collected and only 93 met the basic boundary condition of knowing, after being exposed to a prime the evening before their laboratory visit, what they would be drinking in the laboratory the following day (alcohol or soft drinks). The data available from these 93 participants fell well below the 140-participant threshold indicated by the power analysis and was therefore insufficient for statistically reliable conclusions. Nevertheless, to make the best use of the data that had been collected within the planned design parameters, we supplemented the preplanned statistical analyses with an examination of patterns in the dataset that might have been informative about the eventual utility of this line of research.

To examine the data related to our main hypothesis (i.e., that alcohol expectancies of the participants who expected to drink alcohol later in the day would increase across time as the drinking opportunity became more proximal while the alcohol expectancies of the participants who expected to drink soft drinks would stay relatively neutral), we examined mean patterns of alcohol expectancy salience-valences scores at each timepoint as a function of condition (See Figure 2). Aligned with our predictions, the graph revealed that participants in the alcohol condition provided higher-valenced alcohol associates than participants in the soft drinks condition across all timepoints. Contrary to our predictions, the graph revealed overall negative trends across time for alcohol expectancies and no sign of an interaction effect between time and condition. The observed mean differences between the alcohol expectancies of the two conditions across time, such that the alcohol expectancies in the alcohol condition were more positive than those in the soft drinks condition, were also present after using multilevel modeling to statistically control for gender, affect, and drinker-type. Graphing the multilevel model analysis also revealed a trending (not statistically significant) interaction effect between time and condition, such that the alcohol expectancies of participants in the alcohol condition reduced at a slower rate than those of the soft drinks condition (See Figure 4). Despite the overall negative trend of alcohol expectancies across time leading to the drinking opportunity, the more positive alcohol expectancies from participants anticipating drinking alcohol as compared to participants anticipating drinking soft drinks suggested that participants' anticipation of drinking later in the day may have been reflected in the nature of the associates they provided in the hours prior to their drinking opportunity.

In addition to the differences found in alcohol expectancies between participants anticipating drinking alcohol and participants anticipating drinking soft drinks, changes in these differences consistent with the intent of the manipulation were found after removing participants who drank before or planned to drink after participation. Removing data of participants who drank before or planned to drink after participation resulted in between-condition differences in alcohol expectancies increasing across all timepoints (See Figure 6 as compared to Figure 4). These increased differences were mostly attributed to the alcohol expectancies of the soft drinks group decreasing, although the alcohol expectancies of the alcohol condition also slightly increased. The relatively large decrease in alcohol expectancies of the soft drink group was notable since 11 out of the 15 participants who were removed for drinking before or planning to drink after participation were from the soft drinks condition. Essentially, the removal of participants from the soft drinks condition who acted similarly to participants in the alcohol condition created larger mean differences between conditions, which provided further evidence that participants were affected by the manipulation and that the effect was reflected in the nature of the associates they provided in the hours prior to their drinking opportunity.

To investigate whether the differences in alcohol expectancies between conditions was due to a possible "third variable," we examined the relationship between gender and alcohol expectancies. We found that the alcohol expectancy associates the male participants provided were of similar salience-valence levels between conditions, both sets of alcohol expectancies decreasing in salience-valence across timepoints. Conversely, the alcohol expectancy associates the female participants provided were dissimilar between conditions. The alcohol expectancies from women in the soft drinks condition showed the same level of alcohol expectancies with the same negative trend as the male participants, while the alcohol expectancies from women in the alcohol condition were higher than those from the soft drinks condition and stayed relatively neutral across timepoints (See Figure 3). It was possible that these differing trends were due to our truncated sample (especially the male sample of 28) being underpowered and therefore unreliable. Future research should also explore the possibility that the experimental manipulation used in this study differently affects genders.

When comparing the alcohol expectancies across timepoints to those collected by Benitez and Goldman (2019), the trends were inconsistent. Benitez and Goldman (2019) found that alcohol expectancies stayed relatively neutral on non-drinking days and increased over time on drinking days. In the current experiment, alcohol expectancies decreased across timepoints in both conditions, with the alcohol expectancies from participants in the soft drinks condition (non-drinking days) declining across timepoints at a faster rate than those from participants in the alcohol condition (drinking days). These inconsistent findings may have been due to differences between real-world drinking opportunities and the experimental drinking opportunity, with the declining alcohol expectancies in the current study being an indicator of how the participants perceived the experimental beverage preference taste-test. Although an in-laboratory drinking opportunity was a way to control for social context, it also added a different social context. Participants went into a university building and interacted with a research assistant, who led them through a protocol so that they could ultimately receive course credit—nothing like a college student's typical drinking opportunity. Despite the differences in social contexts between studies, however, and how they might have affected change in alcohol expectancies over time, mean alcohol expectancies on drinking days were consistently higher than alcohol expectancies on non-drinking days in both studies. Future research will be needed to examine how differing social drinking contexts affect the alcohol expectancy associates that participants provide in the hours leading to a drinking opportunity.

In addition to investigating whether the priming/activation of anticipatory processes related to drinking alcohol would affect alcohol expectancies in a way consistent with our theory, we also conducted exploratory analyses to examine whether participants' alcohol consumption during the taste-test was consistent with their alcohol expectancies. Regression analyses indicated that participants' mean alcohol expectancies were not predictive of participants' alcohol consumption during the taste-test, when controlling for gender, drinker-type, previous drinking frequency, and how much participants reported like drinking beer. It was possible that there were not enough participants for reliable statistical results and that alcohol expectancies were simply not statistically predictive of alcohol consumption quantity; however, the very small change in R^2 (0.004) after including alcohol expectancies as a predictor suggested that alcohol expectancies were not correlated with alcohol consumption, statistically or otherwise. Because our theory postulates that alcohol expectancy associates are indicators of the motivation to drink alcohol, analyses should be conducted examining whether the individual variability in salience-valence of alcohol expectancy associates are predictive of alcohol consumption levels.

Additionally, further research should investigate how alcohol expectancy associates relate to alcohol consumption in experimentally-created versus real-world drinking opportunities.

Conclusion

Overall, given the premature conclusion of the current experiment and the resulting truncated dataset, no statistically significant differences between the variables of interest were found. However, examinations of the available data revealed mean trends that were somewhat aligned with our predictions. Although we hypothesized that the alcohol expectancies of the participants in the alcohol condition would increase across time while the expectancies of the participants in the soft drinks condition would stay relatively neutral across time, we found that alcohol expectancies of the participants in the alcohol condition were overall more positive across time as compared to the soft drinks group. This trend remained after controlling for gender, drinker-type, and affect. Furthermore, the differences increased after removing participants who drank before or planned to drink after participation. Although we did not find any trends between alcohol expectancies and alcohol consumption, those examinations were exploratory in the original experimental design and require further investigation. Taken together, experimental control over a drinking opportunity (or no drinking opportunity) resulted in differing alcohol expectancies that were somewhat aligned with our predictions and may have indicated that alcohol expectancy associates could be used as a probe for motivational processes that lead to drinking. With the understanding that these differences were not statistically reliable, more research needs to be conducted to answer the remaining questions.

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