3-17-2020

Episodic Future Thinking as a Brief Alcohol Intervention for Heavy Drinking College Students: A Pilot Feasibility Study

Andrew Timothy Voss

EPISODIC FUTURE THINKING AS A BRIEF ALCOHOL INTERVENTION FOR HEAVY DRINKING COLLEGE STUDENTS: A PILOT FEASIBILITY STUDY

by

Andrew T. Voss

A Thesis Submitted

in Partial Fulfillment of the

Requirements for the Degree of

Masters of Science

Major: Psychology

The University of Memphis

May 2020

Abstract

Episodic Future Thinking (EFT), an exercise that involves cognitive simulation of the future, has demonstrated proximal effects on measures of impulsivity and alcohol demand. However, few studies have investigated EFT's potential to reduce alcohol use outside the lab. This study piloted an academic goal-relevant EFT (A-EFT) intervention for heavy drinking college students. Forty-five heavy drinking undergraduates were randomized to complete a brief A-EFT intervention, or control task. Recruitment rates supported the feasibility of our approach; interest and scheduling rates were high, and booster and follow-up completion rates were good. Participants assigned to A-EFT increased the amount of time spent studying in the evening compared to students assigned to control. Within-group analyses revealed significant decreases in alcohol demand and alcohol consumption, and an increase in protective drinking strategies in the A-EFT group. The current study supports the feasibility, acceptability, and preliminary efficacy of an A-EFT intervention for college student heavy drinkers.

Table of Contents

Introduction

Episodic Future Thinking (EFT) refers to the ability to visualize and simulate future hypothetical personal episodes (Szpunar, 2010). EFT is a cognitive process believed to be unique to humans that developed to address the need to pre-experience and predict outcomes of novel experiences (Suddendorf & Corballis, 2007). Although humans do not typically intentionally engage in prolonged instances of EFT, future prospection is often required and common during practices such as goal implementation, planning, and setting deadlines (Atance & O'Neill, 2001). The ability to envision the future develops at a young age. As early as age 3-5, children begin to demonstrate the ability to conceptualize the future as not simply a replay of the past and to predict that future preferences of self and others will be different from current preferences (Atance & O'Neill, 2005; Bélanger et al., 2014). However, EFT is hypothesized to involve other cognitive mechanisms such as executive processes and working memory (D'Argembeau, Ortoleva, Jumentier, & Van der Linden, 2010; Ferretti et al., 2017). Thus, the ability to imagine the future only fully develops later in childhood as children begin to utilize more complex cognitive processes (Coughlin, Lyons, & Ghetti, 2014).

Cognitive researchers have demonstrated that engaging in EFT relies on the ability to remember specific details of past events (Schacter, 2012; Suddendorf & Corballis, 2007). This suggests that memory of past outcomes and experiences influences our expectations and perceptions of likely future experiences (Atance & O'Neill, 2001). Indeed, amnesic patients who have deficits in memory of the personal past have demonstrated difficulty envisioning possible future events (De Luca et al., 2017; Klein, Loftus, & Kihlstrom, 2002). Specifically, the medial temporal lobes and prefrontal cortex

have been implicated in involvement of thinking of both the past and the future (Gilbert & Wilson, 2007; Okuda et al., 2003) and EFT engages these regions to contemplate future events (Atance & O'Neill, 2001). Although initially evaluated by cognitive scientists, EFT has been recently identified by behavioral economic researchers as a potential intervention to increase time-horizon and reduce health-risk behaviors.

Behavioral Economic Theory

Behavioral Economics (BE) is an approach to understanding addiction that combines principles of behavioral psychology (i.e., operant conditioning) and microeconomics to examine molar patterns of resource allocation to alcohol/drugs versus alternative reward options over time. BE theory suggests that substance misuse is characterized by a pattern of suboptimal choices resulting from overvaluation of immediate rewards from alcohol/drugs relative to delayed rewards often associated with more substance-free prosocial behaviors (e.g., exercising, working or attending class; Bickel, Johnson, Koffarnus, MacKillop, & Murphy, 2014). Although EFT is not a behavioral economic intervention per se, BE has been applied to understand its utility as a potential substance use intervention element. This is because, according to BE theory, overvaluation of drug/alcohol reward is strongly related to a shortened time perspective, or a diminished ability to foresee the long-term negative consequences of drug/alcohol use or the long-term rewards of continued substance-free behaviors. Thus, BE theory suggests that EFT could be used to shift the time perspective of individuals thus increasing the salience of future rewards and decreasing the relative valuation of smaller immediate rewards such as drug and alcohol use (Boyer, 2008).

Delayed Reward Discounting. Delayed reward discounting (DRD) refers to the extent to which individuals discount the value of rewards as a function of temporal delay (Bickel & Marsch, 2001). In studies with human participants, discounting is commonly measured by hypothetical choice tasks that involve choosing between smaller immediate rewards and larger delayed rewards (e.g. “would you rather have $40 today or $80 in 1-month”; Gray, Amlung, Acker, Sweet, & MacKillop, 2014). Although immediate rewards are universally preferred over equal valued delayed rewards, there are individual differences in the degree to which delayed rewards lose value, and steep discounting tendencies reflecting overvaluation of immediate rewards may contribute to impulsive health-risk behaviors associated with immediate reward such as drug and alcohol use. Individuals who value larger future rewards are hypothesized to make more decisions consistent with these long-term rewards (exercising, studying, attending class), whereas, individuals who overvalue immediate reward are more likely to use alcohol and other drugs which are immediately rewarding, but harmful (or at least less rewarding) when aggregated over time (Bickel et al., 2014). Indeed, multiple literature reviews have demonstrated that discounting the value of delayed rewards is greater among substance misusers and that discounting increases as substance misuse severity escalates (Amlung, Vedelago, Acker, Balodis, & MacKillop, 2017; MacKillop et al., 2011). Specifically, greater discounting has shown consistent positive associations with alcohol, tobacco, and heroin use, as well as gambling and other risky behaviors (Amlung et al., 2017; Kirby et al., 1999; Petry, Bickel, & Arnett, 1998; Wu, Cheng, Chiou, 2017).

Alcohol Demand. Alcohol demand is a BE measure of the reward value of alcohol, or the amount of a given resource (e.g., money) one is willing to allocate towards

acquiring and consuming alcohol (MacKillop & Murphy, 2007). Alcohol demand measures attempt to quantify individual differences in reward value of alcohol by evaluating resource expenditure in a variety of ways (e.g., expenditure at low cost, maximum expenditure). Hypothetical purchase tasks can be used to generate demand curves, which plot consumption across various prices and generate several indices of alcohol reward value (MacKillop & Murphy, 2007). Demand indices have shown consistent positive associations with alcohol consumption (Murphy & MacKillop, 2006), alcohol-related problems (Skidmore, Murphy, & Martens, 2014), drinking and driving (Teeters & Murphy, 2015), and other factors indicative of heavy substance use such as impulsivity (Kiselica & Borders, 2013) and craving (MacKillop et al., 2010). In addition, college student drinkers who reported greater alcohol demand demonstrated poorer response to a brief alcohol intervention, in that they continued to drink more and report more heavy drinking episodes (HDE) after controlling for baseline drinking and other relevant covariates (MacKillop & Murphy, 2007). On the other hand, reductions in alcohol demand following intervention predict subsequent changes in drinking and drug use (Dennhardt, Yurasek, & Murphy, 2015; Murphy et al., 2015).

Episodic Future Thinking as a Behavioral Economic Intervention

The goal of EFT then, from a BE framework, is to increase the salience of future rewards, which has the potential to 1) increase preference for prosocial choices and health behaviors leading to those rewards and to 2) diminish preference for less healthy immediately rewarding activities. Envisaging future events as if they are currently happening may increase the value of future rewards by activating reward mechanisms in the brain to pre-experience feelings of reward (Peters & Büchel, 2010), thus reducing

impulsive decision-making (Benoit, Gilbert, & Burgess, 2011) and promoting allocation of behavior towards long-term goals (Boyer, 2008).

In fact, EFT tasks have demonstrated utility in decreasing DRD across several different populations. EFT tasks typically require participants to envisage specific and personalized positive events that could realistically happen in the future. Participants are then presented with personalized episodic cues while completing a discounting task. Based on prior literature examining moderators of the efficacy of EFT, cues are selected based on vividness (Peters & Büchel, 2010) and personal/emotional relevance (Benoit, Gilbert, & Burgess, 2011). Further, cues typically match the hypothetical temporal delay to the larger later reward (e.g., "Paris vacation in 1 year" presented alongside "would you rather have $40 today or $80 in 1-year"). Using this paradigm, EFT tasks have demonstrated proximal reductions in DRD in adult smokers (Stein et al., 2016), college student drinkers (Bulley & Gullo, 2017), college students who meet criteria for alcohol dependence (Snider, Laconte, & Bickel, 2016), and overweight/obese people (Daniel, Stanton, & Epstein, 2013b; Stein et al., 2017), with medium to large effect sizes.

There is also some evidence that EFT and other tasks that promote future oriented thinking can reduce alcohol demand. Several self-report survey studies have demonstrated that demand is significantly reduced when heavy drinking students are told to imagine they have a responsibility the next day, such as an exam or quiz (Berman & Martinetti, 2017; Gilbert, Murphy, & Dennhardt, 2014; Skidmore & Murphy, 2011). Additionally, two studies have demonstrated that EFT can reduce demand for alcohol. Students instructed to envisage positive future events demonstrated significantly less *intensity* of demand compared to controls who envisaged non-personal narratives or past

events (Bulley & Gullo, 2017; Snider, Laconte, & Bickel, 2016). Notably, effects of the EFT task on demand were smaller among students who reported less alcohol consumption compared to those who met criteria for alcohol use disorder. Nonetheless, EFT and other tasks that promote future oriented thinking—even if it is only the next day future—could be utilized to reduce reward value of alcohol and discounting of future rewards.

There is also preliminary evidence that EFT is associated with acute reductions in health-risk behaviors measured in laboratory paradigms. Participants who engaged in EFT earned less cigarette puffs during a self-administration session (Stein et al., 2016) and consumed less calories during tempting food self-administration (Daniel et al., 2013a) compared to control participants. Several studies have also examined the impact of EFT involving the ideal self (future events if desirable aspects of the self were realized) on discounting and substance use. Chiou and Wu (2016) found that EFT involving the ideal non-smoking self, resulted in lower probability of smoking during a self-administration session compared to controls and this reduction was mediated by reduced DRD. In addition, participants in the EFT group reported smoking fewer cigarettes during the following week than controls. In addition, Wu and colleagues (2017) found that reduced discounting mediated the relation between EFT involving the ideal self and less preference for delinquent behavior and lower probability of cheating to earn money during a timed matrices task.

Despite promising initial findings, some recent studies have called into question the validity of the effects of EFT. Specifically, Rung and Madden (2018) found that participants who read a fictional account of an EFT experiment could ascertain the

hypothesis (i.e., that fictional participants assigned to EFT would reduce impulsive choice). However, follow-up studies have found that effects of EFT persisted after controlling for demand characteristics (Stein, Tegge, Turner, & Bickel, 2018). Rung and Madden (2019) also followed up these results and found that only theoretically relevant cues (e.g., cues that enhance episodic prospection) reduced discounting compared to cues that enhanced demand characteristics (e.g., cues that call attention to temporal discrepancy in discounting choice items). Further, O'Donnell (2019) and colleagues determined that EFT cues do not need to match discounting choice delays in order to effectively reduce discounting. Taken together, these results suggest EFT has promise as an efficacious method of enhancing temporal perspective independent of experimental influences. However, these results leave to question whether the process of EFT accounts for effects, or if cues need to be present during decision-making tasks (O'Donnell, Hollis-Hansen, & Epstein, 2019). More generally, it is important to establish EFTs potential to promote change in substance use behavior outside the lab given that only one study to date has investigated short-term longitudinal change (Chiou & Wu, 2016).

Episodic Future Thinking and Goal Formation

College students have been a frequent target for alcohol use interventions due to the high levels of alcohol use and associated negative consequences in this population (Hingson, Zha, & Smyth, 2017). Elevated substance use in this age group is partially attributed to a biological propensity to be more impulsive. This propensity is primarily attributed to ongoing structural and functional maturation in prefrontal brain regions, which results in less cognitive control relative to adults (Casey & Jones, 2010). Although young adulthood is characterized by underdeveloped ability to resist impulses to use

alcohol and other drugs (Bechara, 2005), college students are required to develop sustained patterns of behavior necessary to obtain important social outcomes that may not materialize for several years (e.g., graduating college, obtaining a job or advanced degree, future health outcomes). Thus, methods to reduce impulsive choices and promote future oriented thinking are important to consider in tailoring interventions for college student alcohol use. Given that academic engagement is generally inversely related to drinking (Acuff et al., 2017; Palfai & Ralston, 2011), one possible method to increase future oriented thinking is through promotion of meaningful academic goals.

Several studies conducted outside of an EFT paradigm have examined associations between goal formation and college student alcohol use. Palfai and Weafer (2006) found that more self-reported meaningful life goals were associated with less problematic drinking in college students. Research also shows that meaningful academic and achievement related goals predict less heavy drinking, fewer associated problems, and less quantity and frequency of consumption in a heavy drinking college sample (Palfai & Ralston, 2011). In the same study, academic goals were the most frequently identified as meaningful and were the only type of goals associated with less drinking and problems, with more goals predicting fewer HDEs (Palfai & Ralston, 2011). These studies suggest that increasing college student commitment to specific goals has the potential to reduce risky substance use. Furthermore, of the various types of goals that college students report, academic and achievement related goals appear to be the most salient.

Murphy and colleagues have also explored associations between academic goal pursuit and alcohol use. One study found that students who decreased their alcohol use

after receiving an alcohol brief motivational intervention (BMI) also increased their engagement and enjoyment of academic activities (e.g. studying, attending class, etc.) (Murphy, Correia, Colby, & Vuchinich, 2005). In addition, Murphy and colleagues (2012) developed a brief one-session intervention, the *substance free activity session* (SFAS), that is designed to increase the salience of academic and career goals by asking about these goals, the current behaviors required to obtain the goals, the future benefits of the goals, and the potential impact of substance use and goal attainment. The SFAS coupled with an alcohol focused BMI reduced heavy drinking and associated problems at 1- and 6-month follow-up relative to a control condition (Murphy et al., 2012). Recent findings have replicated drinking reductions post BMI/SFAS in a larger sample and extended effects out to 16-months (Murphy et al., 2019).

Finally, two studies to date have examined goal-relevant episodic future thinking in college students. O'Donnell, Daniel, and Epstein (2017) found that financial goal-oriented EFT was more effective at reducing DRD in college students than a general EFT task. The financial goal-oriented EFT task instructed participants to imagine future positive events related to financial gain, compared to envisaging any positive event. Another recent study by Lapp and Spaniol (2017) examined four categories of goal-related EFT (interpersonal, achievement, health, and duties/obligations) and found that college age participants rated achievement goal-related EFT as the most positive, emotionally evocative, and personally significant. However, no study to date has tested the utility of an academic goal-relevant EFT task in increasing future orientation and decreasing alcohol use in a sample of college student drinkers.

Present Study

The current study included modifications to existing EFT paradigms in order to evaluate potential to promote lasting change in drinking behavior and increase relevance for college students. First, the study attempts to extend the temporal reach of EFT interventions which have demonstrated immediate reductions in discounting (Bulley & Gullo, 2017: Snider, Laconte, & Bickel, 2016), and alcohol demand (Bulley, & Gullo, 2017; Snider, Laconte, & Bickel, 2016) by utilizing a longitudinal design to evaluate whether EFT can change drinking behavior outside the lab in heavy drinking college students. The two-group experimental design included an active control group, weekly booster contact, and 1-month follow-up. Second, this study seeks to investigate whether the process of engaging in EFT is sufficient to produce effects when cues are not presented during the decision-making task (O'Donnell et al., 2019; Rung & Madden, 2019). Lastly, this study adds an academic goal-related focus to the EFT task based on previous research indicating that forming meaningful academic goals is protective against drinking and associated problems (Murphy et al., 2012; Palfai & Ralston, 2011; Palfai & Weafer, 2006).

Thus, the present study investigated the feasibility, acceptability, and initial utility of a brief academic goal-relevant episodic future thinking (A-EFT) task among heavy college drinkers. Despite being similarly powered as previous studies that have found robust proximal effects (Daniel, Stanton, & Epstein, 2013b; O'Donnell, Daniel, & Epstein, 2017) and substance use change out to one week (Chiou & Wu, 2016), the current sample is underpowered to detect treatment effects and it is important to note that small pilot trials can inflate effect sizes (Leon, Davis, & Kraemer, 2011). Thus, consistent

with recommendations by Leon and colleagues (2011), the primary aims are to present data related to feasibility and acceptability of the intervention. Data will include, initial interest/scheduling rates, participant's rating of the A-EFT task, booster and follow-up retention rates, and sufficient procedural detail to allow for replication and extension with studies better equipped to evaluate treatment efficacy.

As a secondary aim, we evaluated initial efficacy data by examining between- and within- condition change on several proximal and longitudinal outcomes. Proximal outcomes included delayed reward discounting and alcohol demand and longitudinal outcomes included alcohol consumption, and alcohol-related consequences. We also included longitudinal outcomes of academic engagement and protective drinking strategies based on previous findings of these variables increasing following academic-focused interventions (Murphy et al., 2012; Murphy et al., 2019).

Method

Participants

Participants were 45 undergraduate students from a large public University in the southern United States. Students were eligible if they were enrolled in their first or second year and were between the ages of 18-25. Age restrictions were based on previous findings on age influencing the ability to produce sufficiently vivid and descriptive future events, as is required during EFT (Addis, Wong, & Schacter, 2008). Eligible participants endorsed at least two past-month heavy drinking episodes (4/5 standard drinks for females/males, respectively), or met the National Institute on Alcohol Abuse and Alcoholism criteria for risky drinking (NIAAA; > 7/14 drinks in the past week for females/males, respectively). Additionally, students who endorsed current or past

treatment for substance abuse or current moderate to severe depressive symptoms were excluded to avoid possible confounding effects (Katayama et al., 2019; Macleod & Salaminiou, 2001).

Detailed participant characteristics are reported in Table 1. The sample included mostly women (73%); 53% identified as White/Caucasian, 27% identified as Black/African-American, 6.7% identified as Native American/Alaskan, 2.2% identified as Asian, and the remaining 11.1% identified as two or more racial/ethnic groups. All participants were full-time students and reported an average GPA of 3.23 (SD = 0.5).

Procedures

Participants were recruited through the University of Memphis SONA system or via campus wide research participation solicitation emails. Either college students enrolled in mandatory introductory psychology courses were awarded research credits for participating in a brief online screening survey, or they completed the screener via campus wide emails and were entered into a raffle with a 1-in-100 chance of winning a $50 gift card. After screening, students voluntarily elected to provide contact information if they wished to participate in the full study. If the students were eligible, they were contacted by the researchers via provided email or cell phone contact to confirm eligibility and schedule for the baseline appointment.

Once participants arrived for the study, they provided informed consent and were randomly assigned to a group. In addition, randomization groups were stratified according to frequency of past-month binge episodes, and GPA. Randomization was accomplished using a random sequence generator where participants within each stratification group had a 50/50 chance of being assigned to either condition.

Randomization procedures were adjusted based on an urn approach in the event of unmatched groups based on stratification criteria (Wei & Lachin, 1988). All participants completed a brief survey before (~30-minute) and immediately after (~5-minutes) the experiment according to procedures used in previous EFT studies that examined changes in discounting and/or demand across two groups (Bulley & Gullo, 2017; O'Donnell, Daniel, & Epstein, 2017; Snider, Laconte, & Bickel, 2016). Survey measures are described below. Each task was expected to take approximately 30-minutes and participants were given $25 for completing the baseline appointment, which in total lasted approximately 65-75-minutes on average. Participants were given an additional $25 dollars for completing the 1-month follow-up which consisted of an additional 30-minute survey and debrief. Participants completed the survey and experimental tasks on a desktop computer in a private room and were provided instructions by one of several graduate research assistants.

Academic Episodic Future Thinking Task (A-EFT). This task was a modified version of the task used by O'Donnell, Daniel, and Epstein (2017). Modifications to the tasks involved inclusion of academic rather than financial goals, while overall length and number of cues generated remained the same. Participants in the A-EFT condition were instructed to imagine and record two positive life events associated with their short-term and long-term academic goals that could likely happen at different time points in the future (approximately 1-month, 3-months, 2 years, 3 years). Participants were informed that their positive life events should be related to the successful completion of an academic or achievement related goal (e.g., "Please think about and briefly name a positive event related to academic achievement that could realistically happen or that

you could plan 1-month from today"). Time points were chosen to roughly correspond with the middle and end of the current semester, college graduation, and one year after graduation, respectively, and thus differed slightly across participants depending on their current year in school.

Research assistants instructed participants to choose academic goals that they were currently pursuing, but had not yet achieved (e.g. "I hope to get an A on my midterm in 1-month" or "I plan to graduate in 2 years with a 3.5 GPA"). After choosing the initial events, participants were instructed to rate each event on four factors (How important is the event? How exciting is the event? How much do you like/enjoy this event? How well can you visualize the surroundings and thoughts/feeling associated with this event?) using a 1-5 Likert-type scale. The researcher instructed participants to choose the event scored the highest at each time point and asked them to briefly visualize the event and then to write (on the computer) about the details of that event as if it was currently happening (i.e. using "I am" statements) for 3-5 minutes. If participants stopped writing before 3 minutes, the researcher prompted them to include as much detail as possible (e.g., "Where are you? Who are you with? What are you thinking/feeling?"). Research assistants remained in the room to provide instructions for each time point as well as additional prompts if necessary but remained outside for a majority of the session. Each participant wrote about four total events and sessions lasted approximately 30-minutes on average.

Next, the researchers made copies of each of the four passages to generate cues for weekly booster contact. Once weekly, researchers texted participants a brief description of one short term and one long term goal in their own words and asked that

they respond indicating they received and read each text. In addition, each text contained instructions to re-visualize episodic details associated with future cues. To encourage engagement in EFT, boosters' texts contained as much personalized vivid imagery and emotion laden language as possible (e.g., "you are sitting at home feeling *beyond excited* that you got your desired grade. . . you *feel like you want to jump up and down* and are convinced nothing can change this positive mood"). All text messages were sent using an encrypted, free to download smartphone text-messaging app (*Wickr*; wickr.com) which automatically deleted texts from the researchers after a set period (1-6 days).

Vivid Memory Task (VMT). Participants in the control group were instructed to read two chapters of "Pinocchio" (Collodi, 1995), which contains a significant amount of vivid imagery and description (e.g. "for the tip of his nose was so round and red and shiny that it looked like a ripe cherry"). After reading each chapter, participants were instructed to list four events or actions that they enjoyed from that chapter (8 total). Participants proceeded to rate each event/action on the same Likert-type scales as the A-EFT group (e.g., How important was this event? How exciting was this event? Etc.). The four events with the highest average rating were selected and participants were asked to briefly recall and write about as many details as possible associated with each event for a brief period (1-2 minutes). This is an active control group modeled after procedures used by Bulley and Gullo (2017) that ensures both groups engaged in a type of mental imagery and did so for a similar amount of time as the experimental group (30-minutes). Research assistants provided instructions after each chapter was read but allowed participants to write in private. We considered asking control participants to recall recent personal events as is common in existing EFT paradigms (Snider, Laconte, & Bickel, 2016; Stein

et al., 2016). However, because similar controls could likely cause heavy drinking students to recall recent positive alcohol-related events such as a party or celebration with alcohol, we chose a previously used control group with standard, neutral recall of vivid non-personal imagery. Procedures for booster contact were similar to the A-EFT group, in that research assistants texted participants weekly with summaries which contained vivid descriptions in their own words of the most highly rated event from each chapter. VMT boosters contained instructions to recall any other details associated with each episodic memory cue.

Follow-Up. After 1-month, participants came into the lab and completed the measures described below. At follow-up, participants in both conditions completed questionnaires assessing their recall of what was written in the task and number of booster texts read. After completion of the survey and closing measures, participants were paid, thanked for their time, and debriefed.

Measures

Cue and Session Ratings. Similar to previous studies (O'Donnell, Daniel, & Epstein, 2017; Snider, Laconte, & Bickel, 2016), participant rated cues in both conditions according to vividness, excitement, importance and enjoyment (1-5). To assess acceptability, after completion of the task, participants in both conditions also rated how enjoyable, personally relevant, and interesting the session was as well as how likely they would be to recommend it for a friend on a 1-9 Likert-type scale. To assess feasibility, recruitment and retention rates were documented as well as booster completion. Booster completion was collected via participant response indicating they had read each text and followed instructions.

Demographic Information. Basic demographic information was collected such as age, sex, race/ethnicity, year in school, and GPA.

Academic Engagement. A single item asked participants to record how many hours over the past week they spent studying after 7:00PM. Evening studying was used as a secondary outcome measure and a proxy of future orientation due to previous findings of the inverse relationship between substance use and evening studying (Murphy et al., 2005) and findings which suggest that greater future orientation is strongly associated with greater academic engagement (Acuff et al., 2017).

Alcohol Consumption. The Daily Drinking Questionnaire (DDQ; Collins, Parks, & Martlett, 1985) was used to measure how much participants drank on a "typical week" in the past month. For each day of a typical week participants indicated frequency of standard drinks and time spent drinking. Items were summed to estimate typical weekly drinking. The DDQ is an established measure that is strongly correlated with self-monitored drinking reports (Kivlahan, Martlatt, Fromme, Coppel, & Williams, 1990). Participants also completed items assessing how many heavy drinking episodes (5/4 drinks per occasion for men/women) they had engaged in over the past month.

Consideration of Future Consequences. The Consideration of Future Consequences Scale (CFCS; Strathman et al., 1994) was used to assess baseline trait future orientation. The CFCS consists of 9-items that assess how much participants consider future positive and negative outcomes of current behaviors. Items include: "I consider how things might be in the future and try to influence those things with my day to day behavior" and "often I engage in a particular behavior in order to achieve

outcomes that may not result for many years." Responses are made on a Likert-type scale ranging from 1 (*extremely uncharacteristic*) to 5 (*extremely characteristic*). Items are summed to create a composite score, which has demonstrated good internal consistency and test-retest reliability (Strathman et al., 1994). Future orientation was evaluated at baseline due to previous associations with drinking outcomes (Murphy et al., 2012). Internal consistency in the present sample was .81.

Delay Discounting. Delayed reward discounting was measured using the 5-trial adjusting delay task (Koffarnus & Bickel, 2014). The task consists of five hypothetical choices between $100 delivered after a delay and $50 delivered immediately. The delay period started at 3 weeks and titrated over each following trial until an indifference point was reached (Koffarnus & Bickel, 2014), with the magnitude of the final delay used to determine the discounting rate parameter (*k)*. Discounting parameters were calculated using recommendations by Koffarnus and Bickel (2014) with higher *k* values indicating a greater proportion of choices for smaller immediate rewards. Hypothetical monetary choice tasks have shown good evidence for reliability and validity (MacKillop et al., 2011) and the 5-trial adjusting delay task has been previously validated with undergraduate students (Koffarnus & Bickel, 2014). In addition, the 5-trial adjusting delay task has demonstrated sensitivity to EFT manipulation (Stein et al., 2017).

Alcohol Demand. Alcohol demand was assessed using the Alcohol Purchase Task (APT; Murphy & MacKillop, 2006). The APT is a hypothetical purchase task that examines self-reported financial expenditure on alcoholic beverages at a variety of drink prices. The APT instructs participants that they should expect to consume each drink they purchase within a specific time frame and that each drink is a standard sized beer (12

oz.), glass of wine (5 oz.), or shot of liquor (straight or mixed, 1.5 oz.). Drink prices included twenty options ranging from zero (free) to $20 per drink. The current study utilized a previously established and validated APT that presented students with a hypothetical scenario of an exam (worth 30% of their final grade) the following morning (Berman & Martinetti, 2017; Skidmore & Murphy, 2011). Due to the nature and relevance of the current intervention, the next-day responsibility APT was used as the primary outcome measure of alcohol demand.

The APT provides multiple indices that indicate different aspects of the severity of alcohol demand. The current study elected to use the demand indices that have demonstrated good reliability (Acuff & Murphy, 2017) and the most robust associations with alcohol use: *intensity*, O_{max}, and *elasticity* (Acuff, Amlung, Dennhardt, MacKillop, & Murphy, 2019; Zvorsky et al., 2019). Demand *intensity* refers to the number of drinks purchased at zero cost (when drinks are free), O_{max} refers to maximum expenditure value, and *elasticity* refers to sensitivity of reported consumption to increases in cost. Prior to calculating indices, demand data were screened for nonsystematic responding using an open source Demand Curve Analyzer (DCA; Gilroy, Kaplan, Reed, Koffarnus, & Hantula, 2018). The DCA was also used to calculate elasticity using default settings based on Koffarnus and colleagues' (2015) exponentiated version of Hursh & Silberberg's exponential equation (2008).

The DCA utilizes three criteria for screening put forth by Stein and colleagues (2015): 1) *trend*, which identifies when demand does not change significantly across prices (detection limit set to 0.25) 2) *bounce*, which identifies nonsystematic local fluctuations (detection limit set to 0.1) and 3) *reversals from zero* (detection limit set to

1). Of the three, the trend criteria was the only one violated by 11.1% of participant data at baseline, 17.7% at post-session, and 22.5% at follow-up. For these participants, elasticity values were not calculated but intensity and O_{max} values were retained due to the absence of other criteria violations. Increased rates of violation at post-session and follow-up were primarily attributed to minimal or no reported demand for alcohol at these time points.

Alcohol-Related Consequences. The Brief Young Adult Alcohol Consequences Questionnaire (BYAACQ) was used to assess alcohol-related consequences. The BYAACQ consists of 24-items that ask participants to endorse experiencing various consequences at least once in the past 30 days (Kahler, Strong, & Read, 2005). Categories of consequences include, social-interpersonal, blackout drinking, academic/occupational, self-care, risk behaviors, physical dependence, and impaired control (Read, Kahler, Strong, & Colder, 2006). The BYAACQ demonstrated good internal consistency in the current sample ($\alpha = .83$).

Protective Behavioral Strategies. The Protective Behavioral Strategies Survey (PBSS; Treloar, Martens, & McCarthy, 2015) was used to assess protective strategies used to regulate alcohol consumption. The PBSS consists of 20-items assessing the frequency (*Never – Always*) with which participants use twenty various strategies. For the purposes of the current studying, strategies were categorized into those used regularly (e.g., *usually* or *always*) versus infrequently (e.g., *rarely, occasionally, sometimes*) or never. The PBSS was used as a secondary outcome and indicator of more responsible drinking due to previous findings of PBS use increasing post-intervention (Murphy et al.,

2019; Voss, Soltis, Dennhardt, Martens, & Murphy, 2018). Internal consistency in the present sample was good (α = .88)

Data Analysis Plan

Prior to analyses, all data were inspected for skewness, kurtosis, and outliers, and adjusted or transformed if necessary, based on criteria by Tabachnick and Fidell (2007). Independent samples *t*-tests were used to evaluate baseline differences in continuous variables and chi-square to investigate differences in dichotomous variables. To examine feasibility of the protocol, we collected initial interest rates and enrollment rates, booster completion, and follow-up rates. To determine acceptability, we examined quantitative ratings of the intervention (and control) session as well as likelihood of recommending the intervention to a friend. We used *t*-tests to compare ratings across the two groups.

To examine preliminary treatment effects, repeated measures ANOVAs were used to assess differences in demand, discounting, academic engagement and alcohol consumption and associated variables in the two groups over time. Paired samples *t*-tests were used to describe within-subject change. Because of the underpowered nature of this pilot/feasibility trial, of primary interest was the calculation of effect sizes. Cohen's *d* effect sizes were included for both between (d_b) and within (d_w) condition effects, with values of ~0.2 indicating a small effect, ~0.5 indicating a moderate effect, and ~0.8 indicating a large effect (Cohen, 2013). Correlations between measures at each time point were considered in calculation of within-condition effect sizes as per recommendations by Cohen (2013). Effect sizes should be taken as initial estimates and interpreted with caution, as per recommendations by Leon, Davis, and Kramer (2011).

Results

Descriptive Sample Statistics

Participant characteristics are reported according to group in Table 1. There were no significant differences between groups on any demographic measures. Participants reported drinking on average 11.61 drinks per week (*SD* = 11.3) and endorsed 5.7 alcohol-related consequences in the past month (*SD* = 3.8). There were no significant baseline group differences on any outcome variable (see Table 1).

Feasibility

Participant recruitment and retention is outlined in Figure 1. Screening was non-targeted and thus initial screening included a large number of students (*N* = 1,512), most of whom did not meet basic inclusion criteria (e.g., freshman or sophomore, 18-25 years old). Further, of eligible participants, 52% did not elect to provide contact information or were ineligible upon phone screening. Of the participants who provided contact information and were confirmed eligible, 82% indicated interest, and 80% of those interested completed the baseline appointment. All participants who completed the intervention or control session completed the post-session assessment and at least one booster; 85% of EFT participants and 76% of controls who completed all three. Finally, 87.5% (*n* = 21) of A-EFT participants and 90% of controls (*n* = 19) completed the 1-month follow-up assessment.

Intervention Acceptability and Adherence

As expected, participants rated selected A-EFT cues significantly higher on each of the four rating scales compared to VMT cues (see Table 2). Specifically, participants rated their future thinking cues as considerably more vivid, positive, exciting, and

important than the recalled narrative cues. Nonetheless, ratings of VMT cues were on average at or above the midpoint, similar to previous results using the same control condition (Bulley & Gullo, 2017; Daniel, Stanton, & Epstein, 2013b). Cue ratings for both groups were not significantly correlated with outcomes. Mean participant ratings indicated that engaging in A-EFT was enjoyable (M = 7.5, SD = 1.6), personally relevant (M = 7.8, SD = 1.9), and interesting (M = 7.2, SD = 1.8) and indicated they would be highly likely to recommend it to a friend (M = 8.1, SD = 1.6). However, only personal relevance ratings were significantly higher than participant ratings of the VMT task (p = .04). Participants assigned to A-EFT wrote for an average duration of 261 seconds (SD = 24.05) and wrote an average of 117 words per passage (SD = 11.13). Participants assigned to VMT wrote for a duration of 110 seconds on average (SD = 4.63) and wrote an average of 52 words per passage (SD = 32.25). Differences in word count and writing duration were expected due to time spent reading in the control condition (see *Procedures*). Word count and post-session ratings were not significantly correlated with outcomes.

Changes in Outcome Variables

Treatment vs. control comparisons.

Post-session outcomes. Repeated measures ANOVAs revealed no significant time by condition effects on post-session intensity ($F(2,43) = 3.26$, $p = .08$) or other indices of demand, with similar results for delayed reward discounting ($F(2,41) = 0.78$, $p = .38$).

1-month outcomes. There were no significant condition differences in change in weekly drinking ($F(2,37) = 1.46$, $p = .24$), alcohol-related consequences ($F(2,38) =$

4.60, p = .07), protective behavioral strategies (F(2,38) = 1.32, p = .26), or heavy drinking episodes (F(2,38) = 0.06, p = .94). However, there was a significant effect of condition on academic time allocation (F(2,38) = 5.38, p = .02, d_b = 1.19), such that participants who visualized successful outcomes of their academic goals increased the mean hours per week spent studying in the evening compared to control participants (see Figure 2).

Within-condition change.

Post-session outcomes. Paired samples *t*-tests indicated a significant within-condition reduction in intensity of demand in the A-EFT group (MeanΔ = -2.13, p = .02, d_w= .49), with little change in the VMT condition (MeanΔ = 0.23, p = .63, d_w = 0.06; see Table 3)[1]. There was no change in other demand parameters or in delay discounting in either condition.

1-month outcomes. Paired samples *t*-tests comparing baseline to follow-up showed no changes in demand or delay discounting in either group (see Table 4). Participants in the A-EFT condition significantly reduced their weekly drinking (MeanΔ = -6.90, p = .02, d_w = .58) from baseline to follow-up, with only marginal, non-significant change in the control condition (MeanΔ = -2.18, p = .16, d_w = .28; Table 4). In addition, both the A-EFT (MeanΔ = -2.04, p = 0.049, d_w = 0.45) and VMT conditions (MeanΔ = -2.14, p = 0.047, d_w = 0.49) significantly reduced number of past-month heavy drinking episodes to a similar extent. Participants in the A-EFT condition increased use

[1] Similar findings were observed for the standard Alcohol Purchase Task.

of protective strategies (MeanΔ = 2.00, p = .021, d_w = .56), with little change in the VMT condition (MeanΔ = 0.56, p = .58, d_w = .12). A-EFT participants reported marginally reduced alcohol-related consequences (MeanΔ = -1.15, p = .08, d_w = .31) compared to a non-significant increase reported by VMT participants (MeanΔ = 0.40, p = .64, d_w = .13). Finally, there was a small increase in evening studying in the A-EFT group (MeanΔ = 1.35, p = .35, d_w = .23) and a significant decrease in the VMT group (MeanΔ = -2.80, p = .02, d_w = .56).

Discussion

The current study was the first to investigate the feasibility, acceptability, and preliminary efficacy of academic goal-relevant episodic future thinking as an intervention to decrease drinking behavior and increase future orientation among college student drinkers. We sought to implement a novel EFT intervention that asked participants to visualize successful outcomes of current academic/achievement goals. Further, while the current EFT intervention reminded students of their personalized cues in the form of weekly boosters, it did not present cues alongside discounting or demand choice tasks. Results indicated that the protocol is feasible and provide strong support for acceptability of the intervention and associated booster texts. Not surprisingly given the small sample size and that fact that participants were not seeking treatment or ostensibly motivated to change their drinking, we did not observe significant between-group treatment effects on alcohol demand, delayed reward discounting, or 1-month outcomes of alcohol consumption, alcohol-related consequences, or protective behavioral strategies. Nonetheless, engaging in A-EFT had a large positive effect on academic engagement at

1-month follow-up. Further, we observed significant within-condition change across the majority of outcomes in the experimental group.

Some of the most promising data regarding feasibility of the current protocol are the high completion rates of boosters. Specifically, all participants across conditions responded to at least one booster indicating that they had read the material and followed instructions, while the majority of experimental participants (85%) replied to all three. Considering there was no additional incentive for completing boosters, this outcome is encouraging and provides support for personalized booster contacts to enhance intervention effects. Whether additional prompting is required to encourage further engagement in episodic thinking during booster contact or if increasing number of weekly boosters becomes overly burdensome should be evaluated in future research.

Participant's subjective reactions to the EFT intervention were generally positive, indicating high acceptability. Despite minimal clinician interaction, participant ratings of enjoyment, interest, and personal relevance were high. Participants also indicated that they were very likely to recommend the intervention to a friend. Somewhat surprisingly, participants in the control condition provided similar ratings apart from personal relevance ratings, which were significantly greater in the experimental group. Future trials should evaluate interest and personal relevance of booster texts as well as include qualitative data collection regarding acceptability of the intervention.

Contrary to prior literature, EFT did not reduce delayed reward discounting, which is somewhat surprising given that the current study was similarly powered as previous studies that have found robust proximal effects (Daniel, Stanton, & Epstein, 2013b; Dassen, Jansen, Nederkoorn, Houben, 2016; O'Donnell, Daniel, & Epstein,

2017). Further, the current study used a discounting task previously shown to be sensitive to EFT manipulation (Stein et al., 2018). This unexpected finding may suggest that the process of engaging in EFT is insufficient to reducing discounting apart from presenting cues during the decision-making task (Rung & Madden, 2019). Recent literature has called to question the efficacy of EFT to produce effects outside of cued contexts (O'Donnell, Hollis-Hansen, & Epstein, 2017; Rung & Madden, 2019). The current null findings may lend themselves to the hypothesis that EFT is insufficient to promote lasting discounting reductions

However, this null finding may also be attributed to the nature of academic goals, which often do not have a specific future monetary value. Previous modifications of EFT to include goal-relevant future episodes have instructed participants to visualize specific financial goals, and thus found more robust effects than general EFT (O'Donnell, Daniel, & Epstein, 2017). Considered amongst other discounting null findings among college students (MacKillop et al., 2007; Voss et al., 2018), this finding may reflect measurement limitations hypothetical money choice discounting tasks with college students. Monetary discounting tasks may be less relevant for full-time students who often have less experience making financial decisions or with consistent full- or part-time employment. Considered in the context of the current finding that EFT increased future oriented behavior (i.e., evening studying), future research should compare the utility of existing monetary discounting tasks versus other measure of future orientation. It is possible monetary choice measures are suboptimal measures of delayed reward discounting for emerging adults, many of whom are not financially independent and thus have little experience making financial decisions.

Similarly, there was no significant effect of condition on demand for alcohol. However, when considering within-condition change, the current data provide some support for the hypothesis that thinking episodically about future academic goals may reduce demand for alcohol. Students who completed the A-EFT tasks did significantly reduce their intensity of demand, with no significant change in the VMT condition. This medium effect size reduction is consistent with prior literature demonstrating the effect of EFT on intensity of demand, with small to medium effects (Bulley & Gullo, 2017; Snider, Laconte, & Bickel, 2016) and suggests this effect may persist outside of cued contexts. As expected, this effect was present when participants were presented with a hypothetical next-day responsibility of an exam (Berman & Martinetti, 2017; Glibert, Dennhardt, & Murphy, 2014) as well as during the standard APT. Thus, the process of engaging in visualizing successful outcomes of current academic goals may be sufficient to reduce valuation of alcohol in favor of choices to allocate behavior towards goal progression.

There were also no effects of condition on 1-month outcomes including weekly consumption, alcohol-related consequences, and protective drinking strategies. These findings are not surprising given that previous research has not demonstrated that EFT is associated with changes in drinking over time. Nonetheless, we did observe significant within-condition reduction in weekly drinking and protective drinking strategies only among students assigned to the experimental condition. This is the first study to demonstrate longitudinal moderate effect size reductions in drinking and associated variables and increase in protective strategies as a result of a brief A-EFT intervention, but is consistent with the previous finding that EFT reduced cigarette smoking at one

week follow-up (Chiou & Wu, 2016). Further, students who engaged in A-EFT did demonstrate a non-significant trend level reduction in alcohol-related consequences. Taken together, this is initial tentative evidence for the hypothesis that A-EFT could promote more responsible drinking by encouraging college students to organize their behavior around long-term goals (Benoit, Gilbert, & Burgess, 2011; Boyer, 2008). However, the current findings should primarily be used to inform further rigorous studies better suited to evaluate change over time. Further, the current intervention did not make any explicit connection with drinking behavior.

Finally, this is the first study to demonstrate that a brief A-EFT task with weekly boosters can have increased academic engagement out to 1-month. It is worth noting that evening studying was the only outcome associated with significant treatment effects and a large between-condition effect size. This finding is consistent with prior literature that showed increased engagement with academics following a brief intervention and reduction in drinking (Murphy et al., 2005; Murphy et al., 2012). Future research should investigate if increasing academic engagement partially or fully mediates longitudinal effects on substance use which would further highlight the protective effects of academic goal pursuit (Palfai & Ralston, 2011).

It is important to note that the while the current pattern of results is promising, they are not robust or sufficient in order to establish A-EFT as an efficacious standalone intervention. It is crucial to replicate the current findings using larger samples and a longer follow-up period. In addition, despite labeling the current session as an intervention, it is worth noting that it was entirely computer administered and did not make explicit connection between drinking and future goals. This type of intervention

may be more appealing to young adult non-treatment seeking heavy drinkers and has little potential to increase defensiveness. Nonetheless, it is also important to examine ways of improving the potential clinical effectiveness of A-EFT. Potential improvements that have already been examined include continued practice (Mellis, Snider, Deshpande, LaConte, & Bickel, 2019), but novel improvements could incorporate other elements of brief motivational interventions, such as normative feedback (NF). NF interventions have demonstrated reliable effects among college students when delivered in person or via computer (Cadigan et al., 2015). Further, recent support for the acceptability of repeated remotely delivered NF (Merrill, Boyle, Barnett, & Carey, 2018) and NF combined with expressive writing (Young & Neighbors, 2019) suggests potential fluid combination with EFT. Finally, incorporating EFT with other interventions designed to increase goal-directed behavior could further increase efficacy (Daughters et al., 2018; Murphy et al., 2019).

Strengths, Limitations, and Future Directions

The current study had a number of significant strengths and unique contributions. First, the current study utilized stratified randomization methods and a previously used and acceptable control group. Second, this study was the first to investigate change in alcohol use and associated novel variables over time after engagement in EFT. Along these lines, this study provides valuable information for further trials evaluating both proximal and distal outcomes associated with EFT. Third, the study provides evidence for the feasibility and acceptability of personalized booster contacts to enhance intervention effects.

Results for the present study should be considered in the context of a number of significant limitations. First, the study utilized a small sample size was thus underpowered to detect treatment effects. Second, the current sample was comprised primarily of female college students, which limits potential generalizability to other populations. Future study should include larger and more diverse samples. Third, the current study relied on retrospective assessment, which is prone to potential recall errors. Future research should utilize ecological momentary assessment (EMA) or other prospective daily assessment methods to attempt to surpass this issue. Finally, the current study contained only self-report measures; future studies should include more objective data collection strategies such as physiological (e.g., transdermal sensors) assessment methods.

In addition, future research should examine timely delivery of EFT cues via ecological momentary intervention (EMI). The current results suggest that delivering academic goal cues via EMI the night before a test could help shift temporal perspective in favor of more responsible drinking or commitment to studying rather than going out to a party. Future research should investigate the effects of continued practice of EFT or timely cue delivering on outcomes beyond delayed reward discounting.

Conclusions

This pilot randomized control trial lays the groundwork for future randomized trials to assess the efficacy of A-EFT interventions to decrease drinking behavior and increase future orientation. A-EFT could prove to be an efficacious intervention that minimizes defensiveness while encouraging allocation of behavior away from substance use towards valued goal progression. Delivery of A-EFT cues prior to the choice to

engage in heavy drinking vs. alternatives may prove useful, especially in the event of salient next-day responsibility.

References

Acuff, S. F., Amlung, M., Dennhardt, A. A., MacKillop, J., & Murphy, J. G. (2019). Experimental manipulations of behavioral economic demand for addictive commodities: A meta-analysis. *Addiction*.

Acuff, S. F., & Murphy, J. G. (2017). Further examination of the temporal stability of alcohol demand. *Behavioural Processes, 141*, 33-41.

Acuff, S. F., Soltis, K. E., Dennhardt, A. A., Borsari, B., Martens, M. P., & Murphy, J. G. (2017). Future so bright? Delay discounting and consideration of future consequences predict academic performance among college drinkers. *Experimental and Clinical Psychopharmacology, 25*(5), 412.

Addis, D. R., Wong, A. T., & Schacter, D. L. (2008). Age-related changes in the episodic simulation of future events. *Psychological science, 19*(1), 33-41.

Amlung, M., Vedelago, L., Acker, J., Balodis, I., & MacKillop, J. (2017). Steep delay discounting and addictive behavior: A meta-analysis of continuous associations. *Addiction, 112*(1), 51-62.

Atance, C. M., & O'Neill, D. K. (2001). Episodic future thinking. *Trends in Cognitive Sciences*, *5*, 533–539.

Atance, C. M., & O'Neill, D. K. (2005). The emergence of episodic future thinking in humans. *Learning and Motivation, 36*, 126–144.

Bechara, A. (2005). Decision making, impulse control and loss of willpower to resist drugs: a neurocognitive perspective. *Nature Neuroscience*, *8*(11), 1458.

Bélanger, M. J., Atance, C. M., Varghese, A. L., Nguyen, V., & Vendetti, C. (2014). What

will I like best when I'm all grown up? Preschoolers' understanding of future preferences. *Child Development*, *85*(6), 2419-2431.

Benoit, R. G., Gilbert, S. J., & Burgess, P. W. (2011). A neural mechanism mediating the impact of episodic prospection on farsighted decisions. *Journal of Neuroscience*, *31*(18), 6771-6779.

Berman, H. L., & Martinetti, M. P. (2017). The effects of next-day class characteristics on alcohol demand in college students. *Psychology of Addictive Behaviors*, *31*(4), 488.

Bickel, W. K., Johnson, M. W., Koffarnus, M. N., MacKillop, J., & Murphy, J. G. (2014). The behavioral economics of substance use disorders: Reinforcement pathologies and their repair. *Annual Review of Clinical Psychology*, *10*, 641-677.

Bickel, W. K., & Marsch, L. A. (2001). Toward a behavioral economic understanding of drug dependence: Delay discounting processes. *Addiction*, *96*(1), 73-86.

Boyer, P. (2008). Evolutionary economics of mental time travel. *Trends in Cognitive Sciences*, *12*(6), 219-224.

Bulley, A., & Gullo, M. J. (2017). The influence of episodic foresight on delay discounting and demand for alcohol. *Addictive Behaviors*, *66*, 1-6.

Cadigan, J. M., Haeny, A. M., Martens, M. P., Weaver, C. C., Takamatsu, S. K., & Arterberry, B. J. (2015). Personalized drinking feedback: A meta-analysis of in-person versus computer-delivered interventions. *Journal of Consulting and Clinical Psychology*, *83*(2), 430.

Casey, B. J., & Jones, R. M. (2010). Neurobiology of the adolescent brain and behavior: Implications for substance use disorders. *Journal of the American Academy of Child & Adolescent Psychiatry*, *49*(12), 1189-1201.

Chiou, W. B., & Wu, W. H. (2016). Episodic future thinking involving the nonsmoking self can induce lower discounting and cigarette consumption. *Journal of Studies on Alcohol and Drugs*, *78*(1), 106-112.

Cohen, J. (2013). *Statistical power analysis for the behavioral sciences*. Routledge.

Collins, R., Parks, G., & Marlatt, G. (1985). Social determinants of alcohol consumption: The effects of social interaction and model status on the self-administration of alcohol. *Journal of Consulting and Clinical Psychology, 53*, 189 –200.

Collodi, C. (1995). *Pinocchio*. Hertfordshire, Great Britain: Wordsworth Editions Limited.

Coughlin, C., Lyons, K. E., & Ghetti, S. (2014). Remembering the past to envision the future in middle childhood: Developmental linkages between prospection and episodic memory. *Cognitive Development*, *30*, 96-110.

D'Argembeau, A., Ortoleva, C., Jumentier, S., & Van der Linden, M. (2010). Component processes underlying future thinking. *Memory & Cognition*, *38*(6), 809-819.

Dassen, F. C., Jansen, A., Nederkoorn, C., & Houben, K. (2016). Focus on the future: Episodic future thinking reduces discount rate and snacking. *Appetite*, *96*, 327-332.

Daniel, T. O., Stanton, C. M., & Epstein, L. H. (2013a). The future is now: Reducing impulsivity and energy intake using episodic future thinking. *Psychological science*, *24*(11), 2339-2342.

Daniel, T. O., Stanton, C. M., & Epstein, L. H. (2013b). The future is now: Comparing the effect of episodic future thinking on impulsivity in lean and obese individuals. *Appetite, 71*, 120-125.

Daughters, S. B., Magidson, J. F., Anand, D., Seitz-Brown, C. J., Chen, Y., & Baker, S. (2018). The effect of a behavioral activation treatment for substance use on post-treatment abstinence: A randomized controlled trial. *Addiction*, *113*(3), 535-544.

De Luca, F., Benuzzi, F., Bertossi, E., Braghittoni, D., di Pellegrino, G., & Ciaramelli, E. (2017). Episodic future thinking and future-based decision-making in a case of retrograde amnesia. *Neuropsychologia*.

Dennhardt, A. A., Yurasek, A. M., & Murphy, J. G. (2015). Change in delay discounting and substance reward value following a brief alcohol and drug use intervention. *Journal of the Experimental Analysis of Behavior*, *103*(1), 125-140.

Ferretti, F., Chiera, A., Nicchiarelli, S., Adornetti, I., Magni, R., Vicari, S., ... & Marini, A. (2017). The development of episodic future thinking in middle childhood. *Cognitive Processing*, 1-8.

Gilbert, L. J., Murphy, J. G., & Dennhardt, A. A. (2014). A behavioral economic analysis of the effect of next-day responsibilities on drinking. *Psychology of addictive behaviors*, *28*(4), 1253.

Gilbert, D. T., & Wilson, T. D. (2007). Prospection: Experiencing the future. *Science*, *317*(5843), 1351-1354.

Gilroy, S. P., Kaplan, B. A., Reed, D. D., Koffarnus, M. N., & Hantula, D. A. (2018). The Demand Curve Analyzer: Behavioral economic software for applied research. Journal of the Experimental Analysis of Behavior, 110(3), 553-568.

Gray, J. C., Amlung, M. T., Acker, J. D., Sweet, L. H., & MacKillop, J. (2014). Item-based analysis of delayed reward discounting decision-making. *Behavioral Processes, 103*, 256-260.

Hingson, R., Zha, W., & Smyth, D. (2017). Magnitude and trends in heavy episodic drinking, alcohol-impaired driving, and alcohol-related mortality and overdose hospitalizations among emerging adults of college ages 18–24 in the united states, 1998–2014. *Journal of Studies on Alcohol and Drugs, 78*(4), 540-548.

Hursh, S. R., & Silberberg, A. (2008). Economic demand and essential value. *Psychological Review, 115*(1), 186- 198.

Kahler, C. W., Strong, D. R., & Read, J. P. (2005). Toward efficient and comprehensive measurement of the alcohol problems continuum in college students: The brief young adult alcohol consequences questionnaire. *Alcoholism: Clinical and Experimental Research, 29(7)*, 1180-1189.

Katayama, N., Nakagawa, A., Umeda, S., Terasawa, Y., Kurata, C., Tabuchi, H., ... & Mimura, M. (2019). Frontopolar cortex activation associated with pessimistic future-thinking in adults with major depressive disorder. *NeuroImage: Clinical*, 101877.

Kirby, K. N., Petry, N. M., & Bickel, W. K. (1999). Heroin addicts have higher discount rates for delayed rewards than non-drug-using controls. *Journal of Experimental Psychology: General*, *128*(1), 78.

Kiselica, A. M., & Borders, A. (2013). The reinforcing efficacy of alcohol mediates associations between impulsivity and negative drinking outcomes. *Journal of Studies on Alcohol and Drugs*, *74*(3), 490-499.

Kivlahan, D., Marlatt, G., Fromme, K., Coppel, D., & Williams, E. (1990). Secondary prevention with college drinkers: Evaluation of an alcohol skills training program. *Journal of Consulting and Clinical Psychology*, *58*, 805– 810.

Klein, S. B., Loftus, J., & Kihlstrom, J. F. (2002). Memory and temporal experience: The effects of episodic memory loss on an amnesic patient's ability to remember the past and imagine the future. *Social Cognition*, *20*(5), 353-379.

Koffarnus, M. N., Franck, C. T., Stein, J. S., & Bickel, W. K. (2015). A modified exponential behavioral economic demand model to better describe consumption data. *Experimental and Clinical Psychopharmacology*, *23*(6), 504.

Koffarnus, M. N., & Bickel, W. K. (2014). A 5-trial adjusting delay discounting task: Accurate discount rates in less than one minute. *Experimental and Clinical Psychopharmacology*, *22*(3), 222.

Lapp, L. K., & Spaniol, J. (2017). Impact of age-relevant goals on future thinking in younger and older adults. *Memory*, 1-14.

Leon, A. C., Davis, L. L., & Kraemer, H. C. (2011). The role and interpretation of pilot studies in clinical research. *Journal of psychiatric research*, *45*(5), 626-629.

MacKillop, J., Amlung, M. T., Few, L. R., Ray, L. A., Sweet, L. H., & Munafò, M. R. (2011). Delayed reward discounting and addictive behavior: A meta-analysis. *Psychopharmacology*, *216*(3), 305-321.

MacKillop, J., Miranda Jr, R., Monti, P. M., Ray, L. A., Murphy, J. G., Rohsenow, D. J., McGeary, J. E., Swift, R. M., Tidey, J. W., & Gwaltney, C. J. (2010). Alcohol demand, delayed reward discounting, and craving in relation to drinking and alcohol use disorders. *Journal of Abnormal Psychology*, *119*(1), 106.

MacKillop, J., Mattson, R. E., Anderson MacKillop, E. J., Castelda, B. A., & Donovick, P. J. (2007). Multidimensional assessment of impulsivity in undergraduate hazardous drinkers and controls. *Journal of Studies on Alcohol and Drugs*, *68*(6), 785-788.

MacKillop, J., & Murphy, J. G. (2007). A behavioral economic measure of demand for alcohol predicts brief intervention outcomes. *Drug and Alcohol Dependence*, *89*(2), 227-233.

MacLeod, A. K., & Salaminiou, E. (2001). Reduced positive future-thinking in depression: Cognitive and affective factors. *Cognition & Emotion*, *15*(1), 99-107.

Mellis, A. M., Snider, S. E., Deshpande, H. U., LaConte, S. M., & Bickel, W. K. (2019). Practicing prospection promotes patience: repeated episodic future thinking cumulatively reduces delay discounting. *Drug and Alcohol Dependence*, *204*, 107507.

Merrill, J. E., Boyle, H. K., Barnett, N. P., & Carey, K. B. (2018). Delivering normative feedback to heavy drinking college students via text messaging: A pilot feasibility study. *Addictive Behaviors*, *83*, 175-181.

Murphy, J. G., Dennhardt, A. A., Martens, M. P., Borsari, B., Witkiewitz, K., & Meshesha, L. Z. (2019). A randomized clinical trial evaluating the efficacy of a brief alcohol intervention supplemented with a substance-free activity session or relaxation training. *Journal of Consulting and Clinical Psychology*, *87*(7), 657.

Murphy, J. G., Dennhardt, A. A., Yurasek, A. M., Skidmore, J. R., Martens, M. P., MacKillop, J., & McDevitt-Murphy, M. E. (2015). Behavioral economic predictors of brief alcohol intervention outcomes. *Journal of Consulting and Clinical Psychology*, *83*(6), 1033.

Murphy, J. G., Dennhardt, A. A., Skidmore, J. R., Borsari, B., Barnett, N. P., Colby, S. M., & Martens, M. P. (2012). A randomized controlled trial of a behavioral economic supplement to brief motivational interventions for college drinking. *Journal of Consulting and Clinical Psychology*, *80*(5), 876.

Murphy, J. G., & MacKillop, J. (2006). Relative reinforcing efficacy of alcohol among college student drinkers. *Experimental and Clinical Psychopharmacology*, *14*(2), 219.

Murphy, J. G., Correia, C. J., Colby, S. M., & Vuchinich, R. E. (2005). Using behavioral theories of choice to predict drinking outcomes following a brief intervention. *Experimental and Clinical Psychopharmacology*, *13*(2), 93.

O’Donnell, S., Hollis-Hansen, K., & Epstein, L. (2019). Mix and Match: An investigation into whether episodic future thinking cues need to match discounting delays in order to be effective. *Behavioral Sciences*, *9*(1), 1.

O'Donnell, S., Daniel, T. O., & Epstein, L. H. (2017). Does goal relevant episodic future thinking amplify the effect on delay discounting? *Consciousness and Cognition*, *51*, 10-16.

Okuda, J., Fujii, T., Ohtake, H., Tsukiura, T., Tanji, K., Suzuki, K., Kawashima, R., Fukuda, H., Itoh, M., & Yamadori, A. (2003). Thinking of the future and past: The roles of the frontal pole and the medial temporal lobes. *Neuroimage*, *19*(4), 1369-1380.

Palfai, T. P., & Weafer, J. (2006). College student drinking and meaning in the pursuit of life goals. *Psychology of Addictive Behaviors*, *20*(2), 131.

Palfai, T. P., & Ralston, T. E. (2011). Life goals and alcohol use among first-year college students: The role of motives to limit drinking. *Addictive Behaviors*, *36*(11), 1083-1086.

Peters, J., & Büchel, C. (2010). Episodic future thinking reduces reward delay discounting through an enhancement of prefrontal-mediotemporal interactions. *Neuron*, 66, 138–148.

Petry, N. M., Bickel, W. K., & Arnett, M. (1998). Shortened time horizons and insensitivity to future consequences in heroin addicts. *Addiction*, 93, 729–738.

Read, J. P., Kahler, C. W., Strong, D. R., & Colder, C. R. (2006). Development and preliminary validation of the young adult alcohol consequences questionnaire. *Journal of Studies on Alcohol*, *67*(1), 169-177.

Rung, J. M., & Madden, G. J. (2018). Demand characteristics in episodic future thinking: Delay discounting and healthy eating. *Experimental and Clinical Psychopharmacology*, *26*(1), 77–84.

Rung, J. M., & Madden, G. J. (2019). Demand characteristics in episodic future thinking II: The role of cues and cue content in changing delay discounting. *Experimental and Clinical Psychopharmacology, 27*(5), 482-495.

Schacter, D. L. (2012). Adaptive constructive processes and the future of memory. *American Psychologist, 67*(8), 603.

Skidmore, J. R., Murphy, J. G., & Martens, M. P. (2014). Behavioral economic measures of alcohol reward value as problem severity indicators in college students. *Experimental and Clinical Psychopharmacology*, *22*(3), 198.

Skidmore, J. R., & Murphy, J. G. (2011). The effect of drink price and next-day responsibilities on college student drinking: A behavioral economic analysis. *Psychology of Addictive Behaviors*, *25*(1), 57.

Stein, J. S., Tegge, A. N., Turner, J. K., & Bickel, W. K. (2018). Episodic future thinking reduces delay discounting and cigarette demand: an investigation of the good-subject effect. *Journal of Behavioral Medicine*, *41*(2), 269-276.

Stein, J. S., Sze, Y. Y., Athamneh, L., Koffarnus, M. N., Epstein, L. H., & Bickel, W. K. (2017). Think fast: Rapid assessment of the effects of episodic future thinking on delay discounting in overweight/obese participants. *Journal of Behavioral Medicine*, 1-7.

Stein, J. S., Wilson, A. G., Koffarnus, M. N., Daniel, T. O., Epstein, L. H., & Bickel, W. K. (2016). Unstuck in time: Episodic future thinking reduces delay discounting and cigarette smoking. *Psychopharmacology*, *233*(21-22), 3771-3778.

Stein, J. S., Koffarnus, M. N., Snider, S. E., Quisenberry, A. J., & Bickel, W. K. (2015). Identification and management of nonsystematic purchase task data: Toward best practice. *Experimental and Clinical Psychopharmacology*, *23*(5), 377.

Strathman, A., Gleicher, F., Boninger, D. S., & Edwards, C. S. (1994). The consideration of future consequences: Weighing immediate and distant outcomes of behavior. *Journal of personality and social psychology*, *66*(4), 742.

Suddendorf, T., & Corballis, M. C. (2007). The evolution of foresight: What is mental time travel, and is it unique to humans? *Behavioral and Brain Sciences*, *30*(3), 299-313.

Szpunar, K. K. (2010). Episodic future thought: An emerging concept. *Perspectives on Psychological Science*, *5*(2), 142-162.

Tabachnick, B. G., & Fidell, L. S. (2007). *Using multivariate statistics*. Pearson Education Inc.

Teeters, J. B., & Murphy, J. G. (2015). The behavioral economics of driving after drinking among college drinkers. *Alcoholism: Clinical and Experimental Research*, *39*(5), 896-904.

Voss, A. T., Soltis, K. E., Dennhardt, A. A., Martens, M. P., & Murphy, J. G. (2018). Protective behavioral strategies mediate the relationship between behavioral economic risk factors and alcohol-related problems. *Experimental and Clinical Psychopharmacology*, *26*(1), 58

Wei, L. J., & Lachin, J. M. (1988). Properties of the urn randomization in clinical trials. *Controlled Clinical Trials*, *9*(4), 345-364.

Wu, W. H., Cheng, W., & Chiou, W. B. (2017). Episodic future thinking about the ideal self induces lower discounting, leading to a decreased tendency toward cheating. *Frontiers in Psychology*, *8*.

Young, C. M., & Neighbors, C. (2019). Incorporating writing into a personalized normative feedback intervention to reduce problem drinking among college students. *Alcoholism: Clinical and Experimental Research*, *43*(5), 916-926.

Zvorsky, I., Nighbor, T. D., Kurti, A. N., DeSarno, M., Naudé, G., Reed, D. D., & Higgins, S. T. (2019). Sensitivity of hypothetical purchase task indices when studying substance use: A systematic literature review. *Preventive Medicine*, 105789.

Appendix

Tables and Figures

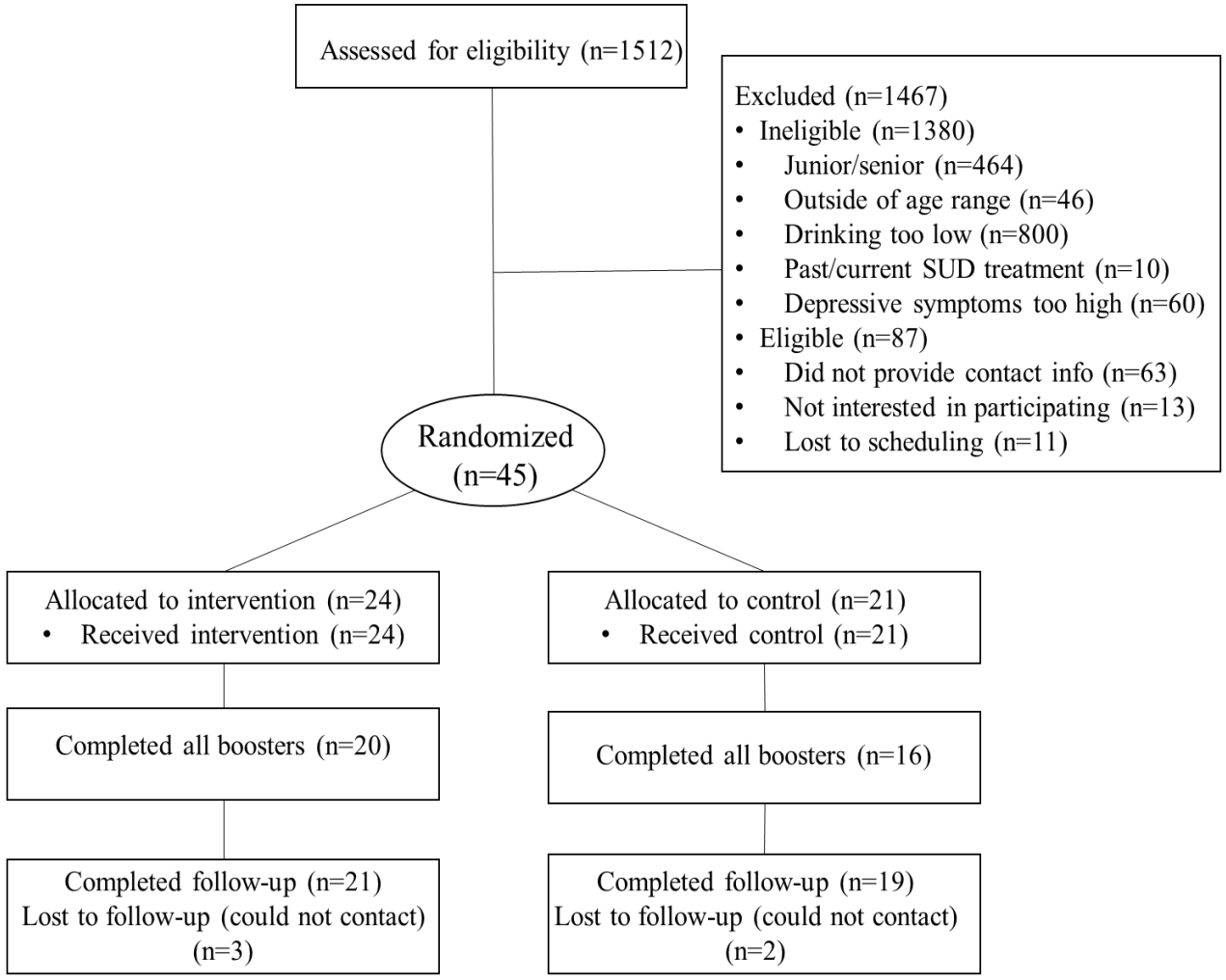
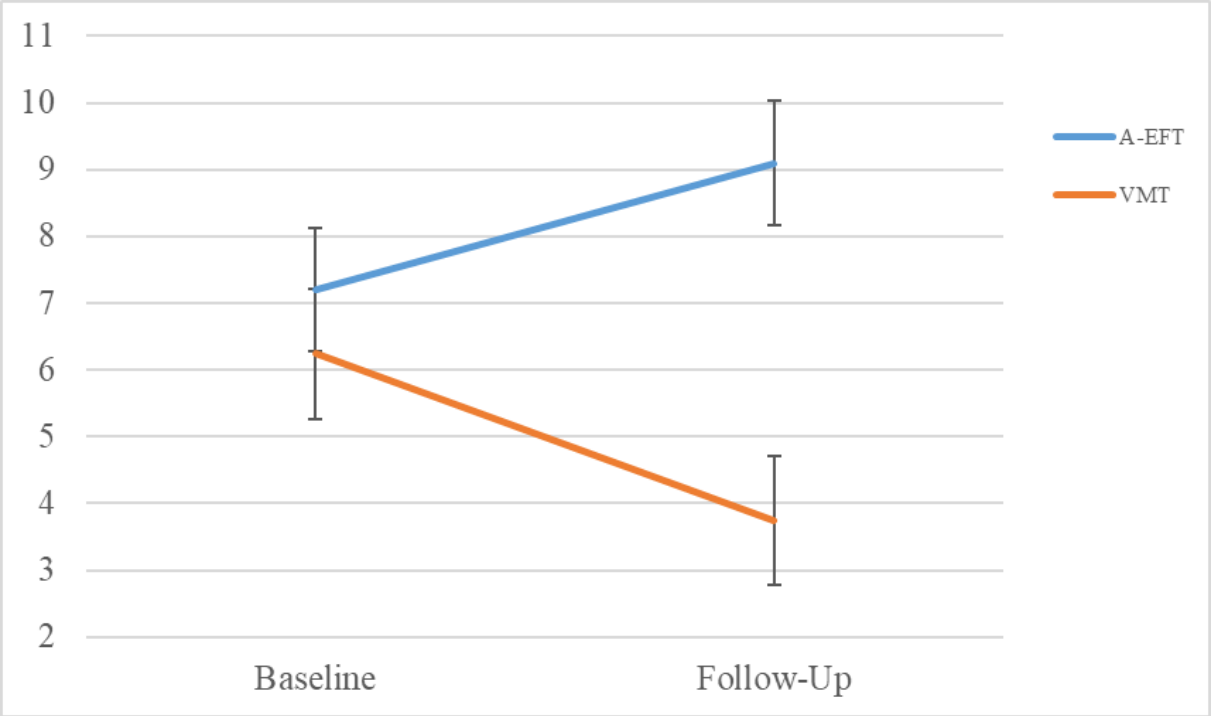


Figure 1. Consort flow chart depicting detailed recruitment, condition assignment, and follow-up rates



Note. A-EFT = academic episodic future thinking; VMT = vivid memory task; error bars = +/- 1 standard error

Figure 2. Change in evening studying hours per week by condition from baseline to 1-month follow-up

Table 1. Means (*SD*) of study variables for full sample and by condition with *t*-test and chi-square results

	Full Sample (N = 45)	**EFT (n = 24)**	**VMT (n = 21)**	***p*-value**
Age	18.9 (1.0)	18.9 (1.0)	18.9 (0.9)	0.99
Race				0.64
White	24 (53.3%)	12 (50%)	12 (57.1%)	
Non-White	21 (46.7%)	12 (50%)	9 (42.9%)	
Sex				0.36
Male	12 (26.7%)	5 (20.8%)	7 (33.3%)	
Female	33 (73.3%)	19 (79.2%)	14 (66.7%)	
Future orientation (CFC)	29.1 (7.4)	29.6 (7.8)	28.7 (6.9)	0.68
GPA	3.23 (0.5)	3.16 (0.6)	3.32 (0.5)	0.83
Evening studying (hours per week)	6.7 (5.7)	7.2 (6.1)	6.2 (5.4)	0.30
Alcohol demand intensity	5.4 (4.7)	6.4 (5.7)	4.3 (2.7)	0.14
Discounting (*k*)	0.105 (.17)	0.106 (.16)	0.104 (.18)	0.97
Typical weekly drinking (DDQ)	11.6 (11.3)	13.1 (12.4)	10.8 (8.4)	0.63
Heavy drinking episodes	4.2 (4.4)	4.2 (4.3)	4.2 (4.4)	0.98
Alcohol-related consequences (BYAACQ)	5.7 (3.8)	5.5 (3.5)	5.9 (4.2)	0.70
Protective drinking strategies (PBS)	11.2 (4.3)	11.1 (4.6)	11.4 (3.9)	0.82

Note. CFC = Consideration of Future Consequences, DDQ = Daily Drinking Questionnaire, BYAACQ = Brief Young Adult Alcohol Consequences Questionnaire, PBS = Protective Behavioral Strategies

Table 2. Cue and Session Ratings by Condition with *t*-test Results

	EFT (n = 24)	**VMT (n = 21)**	***t*(df)**
Cue Ratings (0-5)			
Excitement	4.6 (0.36)	3.0 (0.73)	9.64(43)***
Valence	4.7 (0.37)	3.1 (1.13)	6.16(43)***
Importance	4.8 (0.26)	3.1 (0.89)	7.90(43)***
Vividness	4.2 (0.52)	3.6 (0.75)	3.42(43)***
Session Ratings (0-9)			
Enjoyment	7.5 (1.61)	7.5 (1.57)	0.00(43)
Personal Relevance	7.8 (1.9)	6.4 (2.2)	2.11(43)*
Recommend	8.1 (1.6)	7.5 (2.1)	0.99(43)
Interest	7.2 (1.8)	7.0 (2.0)	0.21(43)

Note. Cue ratings were completed during cue generation, session ratings were completed during the post-session survey; *$p < .05$, **$p < .01$, ***$p < .001$

Table 3. Pre-Post Means (*SD*) and Within-Group Effects for Post-Session Outcomes: EFT v. VMT

	EFT				**VMT**			
	Baseline	**Post-Session**	***t(df)***	***d_w***	**Baseline**	**Post-Session**	***t(df)***	***d_w***
Alcohol demand								
Intensity	6.4 (5.7)	4.3 (4.5)	2.42(23)*	0.49	4.3 (2.7)	4.1 (3.5)	0.48(20)	0.06
Elasticity	.0103 (.01)	.007 (.005)	1.44(17)	0.44	.0118 (.013)	.008 (.005)	0.82(16)	0.38
O_{max}	16.3 (13.8)	12.9 (15.1)	1.13(23)	0.34	12.2 (10.1)	10.6 (10.1)	0.30(20)	0.23
Discounting (*k*)	0.106 (.16)	0.09 (.15)	0.69(21)	0.23	0.104 (.18)	0.12 (.22)	-1.02(20)	0.16

*Note. *p < .05*

Table 4. Pre-Post Means (*SD*) and Within-Group Effects for 1-Month Outcomes: EFT v. VMT

	EFT				VMT			
	Baseline	**Follow-Up**	***t(df)***	***d_w***	**Baseline**	**Follow-Up**	***t(df)***	***d_w***
Weekly drinking	12.4 (12.5)	7.1 (6.7)	2.64(19)*	0.58	10.8 (8.4)	8.4 (9.6)	1.45(18)	0.28
HDE	4.2 (4.3)	2.4 (3.5)	2.14(19)*	0.49	4.2 (4.4)	2.9 (3.7)	2.11(18)*	0.45
BYAACQ	5.5 (3.5)	4.7 (2.6)	1.84(16)	0.31	5.9 (4.2)	6.4 (5.2)	-0.47(16)	0.13
PBS	11.1 (4.6)	13.2 (4.4)	-2.52(19)*	0.56	11.4 (3.9)	11.9 (4.9)	-0.56(18)	0.12
Evening studying	7.7 (6.1)	9.1 (5.5)	-0.95(19)	0.23	6.6 (5.4)	3.8 (3.2)	2.56(19)*	0.56
Alcohol demand								
Intensity	6.4 (5.7)	4.7 (4.4)	1.69(19)	0.37	4.3 (2.7)	3.7 (2.7)	1.39(18)	0.25
Elasticity	.0103 (.01)	.007 (.006)	0.75(15)	0.40	.0118 (.013)	.011 (.010)	0.41(13)	0.07
O_{max}	16.3 (13.8)	16.6 (15.4)	-0.38(18)	0.03	12.2 (10.1)	10.3 (9.6)	0.78(18)	0.25
Discounting (*k*)	0.106 (.16)	0.07 (.11)	0.78(19)	0.27	0.10 (.18)	0.12 (.19)	-0.83(18)	0.11

Note. HDE = Heavy drinking episodes, BYAACQ = Brief Young Adult Alcohol Consequences Questionnaire, PBS = Protective Behavioral Strategies *$p < .05$