The Effect of Episodic Future Thought on Delay Discounting, Outcome Expectancies, and Alcohol Use among Risky College Drinkers

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Abstract

Positive, but distal consequences of reducing alcohol use among at-risk users may have little impact on behavior due to temporal discounting (Mazur, 1987), in which delayed rewards are devalued relative to more proximal rewards, even if such distal rewards actually provide considerably more value. Delay discounting may be manipulated using a variety of means, one of which involves utilizing prospective thinking about future autobiographical events and is termed *Episodic Future Thinking* (Atance & O'Neill, 2001). Episodic future thinking (EFT) has been demonstrated in previous studies to be effective in reducing delay discounting relative to a variety of control conditions (Benoit, Gilbert, & Burgess, 2011; Daniel, Stanton, & Epstein, 2013a, 2013b; Lin & Epstein, 2014; Peters & Büchel, 2010) and recently among substance-abusing populations (Snider, LaConte, & Bickel, 2016; Stein et al., 2016). The present study examined EFT in a novel sample of at-risk alcohol users. Participants were randomized to EFT, episodic past thinking (EPT), or a control condition in which non-autobiographical events were recalled (CET). Immediately following intervention, results demonstrated significantly less discounting in EFT and EPT, relative to CET. At follow-up, EFT demonstrated significantly less temporal discounting and alcohol use, when compared to both EPT and CET. No differences among conditions in alcohol demand or alcohol use intentions were observed. The present study contributes a number of novel findings to the literature, most notably that engaging in EFT predicts reductions in alcohol use prospectively and that reductions in delay discounting associated with EFT persist at least a week later, without any additional intervention. Such

findings suggest that EFT manipulations influence the valuation of future rewards. Additionally, findings support EFT as a useful supplement to existing empirically-supported treatments or a component of novel substance use disorder treatments.

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General Audience Abstract

Drug and alcohol addiction is characterized by seemingly illogical decisions to forgo important benefits associated with abstinence or moderated use (e.g., maintaining employment) in favor of the immediate gratification of intoxication. The tendency to favor instant gratification and devalue delayed rewards explains impulsive decision making typical of substance use disorders and other impulse control problems. The present study evaluated whether vividly imagining positive future events reduced this tendency toward instant gratification. College students at high risk for an alcohol use disorder participated in the study. Participants were randomly assigned to one of three groups: one in which they were asked to imagine positive events they anticipated in the future, one in which they were asked to imagine positive events from their past, and one in which they were asked to recall events described in a provided travel blog. Immediately after imagining the events, participants in both the past and future conditions were less oriented towards instant gratification than participants who were asked to recall events from a travel blog. When measured a week later, participants in the future condition reported less devaluation of future rewards, as well as less alcohol use, than participants in the other two groups. Overall, the results of the study provide evidence that vividly imagining positive future events reduces impulsivity among at-risk college student drinkers. As such, imagining future events may be an effective component of future treatment efforts for substance use disorders and other impulse control problems.

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Introduction

Substance use disorders, alcohol use disorders in particular, are very common among college students (O'Malley & Johnston, 2002) and contribute to a range of negative consequences including school dropout, legal problems, and physical injury or death (Ham & Hope, 2003). Expectations regarding the consequences of behavior change are theoretically important in the treatment of alcohol and other substance use disorders (Icek Ajzen, 1991; Bandura, 1986). Presumably, college students who are problematic drinkers would seek to reduce their alcohol use if they believed that abstaining or reducing use would facilitate obtaining important life improvements. However, humans, particularly those with impulse control problems, make choices to engage in behaviors in a less than rational, reasoned manner. Substance use disorders are often characterized by impulsive decisions that are seemingly illogical: Individuals with substance use disorders are likely to make "bad decisions" to engage in substance use despite significant potential negative consequences (e.g., failing class) and important positive outcomes of abstaining or moderating use (e.g., graduating from college). Behavioral economic principles may be useful in explaining this paradoxical decision-making (Bickel et al., 2007). The behavioral economic index of temporal, or delay discounting (Mazur, 1987), helps to explain decisions in which the short-term benefits of intoxication are chosen over larger, but delayed, benefits of abstinence. Recent research has sought to reduce delay discounting via a variety of methods (e.g., Bickel, Yi, Landes, Hill, & Baxter, 2012; Daniel et al., 2013b). One such method, *Episodic Future Thinking* (EFT), involves engaging in "mental time travel" by vividly imagining future events (Atance & O'Neill, 2001). Recent research has demonstrated that brief experimental manipulations during which participants are asked to engage in EFT are effective in reducing delay discounting (Daniel, Sawyer, Dong, Bickel, & Epstein, 2016; Daniel et al.,

2013a, 2013b; Snider et al., 2016; Stein et al., 2016). The present investigation will seek to extend the current state of the literature on EFT in order to inform future novel interventions for substance use disorders.

Expectancies

Theorists have long asserted that expectancies play an important role in behavior and behavior change. Rotter (1954) proposed an early definition for the term *expectancy*, defining it as "the probability held by an individual that a particular reinforcement will occur as a function of a specific behavior on his part in a specific situation or situations." Learning theorists Bolles (1972) and Mischel (1974) argued in favor of expectancies' centrality to the reinforcement process, explaining that the stimulus does not directly cause the response; rather, the learned relationship between stimulus and reinforcement is determinative of future response. Thus, expectations about future consequences mediate the relationship between stimulus and response. Subsequent research demonstrated that expectancies about consequences are actually more influential to behavior than actual consequences and led to the development of theories of behavior in which expectations for the future played a pivotal role.

Outcome expectancies, or expectations about the consequence of a given behavior, are featured prominently in many theories of behavior change. In Fishbein's expectancy-value theory, expectancies' multiplicative relationship with outcome value is a primary predictor of behavioral attitudes. The theory of reasoned action (Ajzen & Fishbein, 1973), and it's update the theory of planned behavior (Ajzen, 1991), expanded upon this expectancy-value model to predict behavioral intentions. Within the Theory of Planned Behavior, behavioral intentions are predicted by attitude (expectancy x value), subjective norms, and perceived behavioral control.

Within social cognitive theory, Bandura (1977) indicates that people choose behaviors that are likely to produce positive outcomes, and unlikely to produce negative ones.

Outcome expectancies for substance use. Outcome expectancies are central to a number of evidence-based treatments for substance use disorders. For instance, Marlatt & Gordon's (1985) relapse prevention model explains that individuals with ineffective coping skills are more likely to use substances in a high risk situation as a result of more positive expectancies regarding substance effects. Following from this theory, cognitive behavioral interventions encourage individuals to challenge maladaptive beliefs regarding the positive effects of drug use. Another example of outcome expectancies' application to substance use disorder treatment is motivational enhancement therapy (MET), a treatment that utilizes motivational interviewing and personalized feedback. Often, MET will include a discussion of expectations regarding the consequences of changing substance use. Finally, the Alcoholics Anonymous endorsed strategy of playing the tape, in which the long term consequences of substance use are considered, may be thought of as a cognitive strategy to manipulate expectancies.

Within addiction literature, the term *outcome expectancy* may refer to either the expected effects of a substance or the expected effects of reducing substance use or abstaining (Metrick & Rohsenow, 2013). This paper will differentiate between these conceptualizations by using the term *effects expectancies* to refer to expectancies regarding the effects of the substance and the term *change expectancies* to refer to expectancies regarding substance use change. When contrasted with change expectancies, effects expectancies have been more thoroughly studied within the addiction literature. Effects expectancies have been demonstrated to be associated with alcohol use among various populations (Brown, Goldman, & Christiansen, 1985;

Christiansen & Goldman, 1983), including college students (Brown, 1985a). Studies have also demonstrated that effects expectancies predict substance use, measured prospectively and within the context of treatment (e.g., Brown, 1985b). It should be noted, however, that some effects expectancy findings in relation to alcohol are mixed. For instance, alcohol effects expectancies are often more associated with quantity, but not frequency of drinking (Jones, Corbin, & Fromme, 2001).

Change expectancies. Following the logic of expectancy-value theories, change in substance use behavior should be predicted by expectancies regarding the consequences of change problematic substance use. There is limited research, however, on such change expectancies. There is some support that change expectancies are associated with substance use behaviors. Solomon and Annis (1989) found that greater costs of change were correlated with number of years of problematic drinking and greater benefits of change were correlated with number of drinking days prior to noon; however, neither costs nor benefits was related to alcohol dependence symptoms. In a number of prospective studies, change expectancies measured pre-treatment failed to predict post-treatment substance use (Banes et al., 2011; Fearer, Walker, Stephens, Roffman, & Williams, 2002; Solomon & Annis, 1990). Rollnick and colleagues (1996) did, however, demonstrate a prospective relationship between change expectancies and substance use. They found that, among a sample of at-risk alcohol users, outcome expectancies measured at baseline were predictive of change in alcohol use between baseline and a 6-month follow-up. Other studies of change expectancies have yielded mixed findings, with costs and benefits predicting some outcomes but not others (Cunningham, Sobell, Gavin, Sobell, & Breslin, 1997; Cunningham, Wild, Cordingley, Koski-ja, & Toneatto, 2002). Taken together, the current literature on outcome expectancies indicates that expectancies are an important construct

within substance abuse theory and treatment. Although there is evidence that effects expectancies are predictive of concurrent and future substance use, the literature on change expectancies is at best, mixed. While some studies supported hypotheses that change expectancies would predict future substance use, a number of studies failed to obtain significant prediction from either the perceived costs or benefits of change (Fearer et al., 2002; Solomon & Annis, 1990). In sum, there is sparse evidence that change expectancies predict substance use outcomes.

Temporal Considerations. Expectancy-value theories logically assume individuals are motivated by, and make decisions consistent with, greater positive outcomes. Human decision-making, however, is often more complex that a simple weighing of costs and benefits. Notably, when the content of change expectancies is considered, the benefits are generally delayed and are likely perceived as being less certain, as they tend to be consequences of longer-term changes in behavior. Rodgers and Brawley (1991) found that proximal exercise participation consequences (e.g., better muscle tone, increased strength), when compared to distal outcomes of exercise (e.g., receiving compliments from friends, buying new clothes), were associated with greater outcome expectancy ratings of valence and likelihood. Such findings suggest that more the more distal change expectancies may be less relevant to decision making and behavior.

The lack of consideration of delayed consequences, such as change expectancies, is associated with impulse-control deficits and a tendency to be less future-oriented. A preference toward the present has been demonstrated in a number of studies. An early investigation by Roos and Albers (1965) used the Time Reference Inventory, a short questionnaire in which participants are asked to complete 30 sentences (e.g., *I believe the happiest time of my life is in the*….) by choosing one of the following: *past*, *present*, *future*. Researchers found that those with

more severe substance use disorder pathology were more present oriented and less future oriented. Similar results were subsequently demonstrated using other, standardized measures of temporal preference and will be discussed at greater length later in this introduction (MacKillop et al., 2011; Madden, Petry, Badger, & Bickel, 1997; Reynolds, Richards, Horn, & Karraker, 2004).

Competing Neurobehavioral Decision Systems (CNDS)

Neuroeconomic theory may provide a useful framework with which to understand devaluing of distal, but important expectancies for change. The dual-systems, Competing Neurobehavioral Decision Systems (CNDS) model, proposes that choices are regulated by two competing brain systems, either or both of which may be associated with dysfunction, resulting choices to engage in behaviors that provide instant gratification but may result in long-term negative consequences or forgone opportunities for future reinforcement of greater objective value (Bickel et al., 2007; Bickel, Jarmolowicz, Mueller, Gatchalian, & McClure, 2012). The first system is the impulsive and reward driven which is driven by limbic and paralimbic areas of the brain (Bickel et al., 2007). This impulsive system "competes" with the evolutionarily newer and slower-to-develop (Galvan et al., 2006) self-regulation or executive control system, which is governed by the prefrontal and parietal regions of the brain (Bickel et al., 2007).

Substance Demand. A behavioral-economic indicator of impulsive-system pathology is high demand, or excessive valuation of an immediate reinforcer (Bickel et al., 2016). Greater psychopathology within the impulsive system may be indicated by higher demand. Pathological demand for a substance may be evidenced by greater demand intensity, the quantity of a substance an individual would choose to consume at no cost, or demand inelasticity, the degree to which desire for the substance is unchanged when the relative cost is increased (Kiselica,

Webber, & Bornovalova, 2016). A number of empirically-supported treatments for substance use disorders may be mediated by decreasing demand (Bickel et al., 2016), either by increasing the value of substance-free alternatives (e.g., contingency management and community-reinforcement) or decreasing the relative value of the reinforcer (e.g., pharmaceutical interventions for alcohol use disorder including Antabuse or Naltrexone).

Delay Discounting. Delay, or temporal, discounting is defined as a representation of the degree to which the ability of an outcome to control behavior is decreased as a function of the temporal delay until the outcome occurs (Reynolds, 2006). Delay discounting is analogous to substance demand, as it is a behavioral-economic indicator of pathology within the executive, regulatory system of the CNDS (Bickel et al., 2007).

This discounting in the relative value of a delayed outcome was demonstrated in an early study by Mazur (1987) in which pigeons were presented with choices of smaller-sooner and larger-later food rewards, with varying amounts of food and varying time delays. The pigeons' choices were modeled using a hyperbolic discounting function in which the discounted value was represented by the following equation: $v_d = V/(1+kd)$, where V represents the amount of food (or the objective value of the outcome), d represents the length of delay, and k represents the between-subjects difference in rate of discounting, or sensitivity to delay.

In subsequent research with humans, this sensitivity to delay was demonstrated to be a behavioral marker of substance use disorder and other impulse control pathology (Bickel, Koffarnus, Moody, & Wilson, 2014; Story, Vlaev, Seymour, Darzi, & Dolan, 2014). Greater delay discounting rates, indicating greater delay sensitivity and preference for immediate gratification, are observed among those with alcohol use disorders as well as substance use pathology across a range of substances (MacKillop et al., 2011; Madden et al., 1997; Reynolds et

al., 2004; Vuchinich & Simpson, 1998). Furthermore, studies have demonstrated a relationship between delay discounting and future substance use following treatment (e.g., Krishnan-Sarin et al., 2007; Stanger et al., 2011). For example, Sheffer and colleagues (2012) found those who discounted more were less likely to remain abstinent following a behavioral treatment for tobacco dependence. Among college students, delay discounting is associated with a range of substance use variables including age at first alcohol use and times "passed out" (Kollins, 2003).

In addition to being an indicator of executive system dysfunction, the role of delay discounting in the development and maintenance of substance use pathology may be causal, as when the reinforcement from abstinence is discounted significantly, the relative reinforcement value of substance use is consequently increased (Stein et al., 2016). Indeed, one field study demonstrated that delay discounting predicted BAC prospectively among male bar-goers, an effect that was not explained by baseline BAC (Moore & Cusens, 2010). As such, interventions aimed at decreasing delay discounting may prove effective in reducing problematic use among individuals with substance use pathology.

Changing temporal discounting. Although in the absence of intervention, temporal discounting is relatively stable (Beck & Triplett, 2009; Kirby, 2009), several studies have provided evidence that discounting can be modified as a function of effective behavioral treatment (Black & Rosen, 2011; Landes, Christensen, & Bickel, 2012; Sheffer et al., 2012; Yi et al., 2008). While such studies changed delay discounting indirectly via treatment directed toward substance use, recent studies have developed interventions to target delay discounting directly by utilizing methods aimed at increasing top-down executive control, in accordance with the CNDS model. Methods aimed at decreasing delay discounting via improving executive control include working memory training (e.g., Bickel, Yi, et al., 2012) or mindfulness-based interventions

(Morrison, Madden, Odum, Friedel, & Twohig, 2014) have demonstrated success in manipulating discounting, presumably be improving executive functioning. Additionally, studies evaluating Episodic Future Thinking (EFT), also referred to as prospective thinking or mental time travel into the future, have demonstrated significantly less discounting in EFT conditions, relative to a variety of comparison conditions.

Episodic Future Thinking

EFT is a type of prospection that involves projecting oneself into the future as a method of pre-experiencing a future event (Atance & O'Neill, 2001). EFT differs from simply reading a scripted account of a future event, a process that would likely engage only semantic, but not episodic memory networks. Rather, EFT involves imagining a future situation in which one will be personally involved.

When one engages in EFT, a set of brain regions is activated in a pattern equivalent to patterns observed during the recollection of previous autobiographical experiences (Szpunar, Watson, & McDermott, 2007). It is believed that these episodic memory networks are activated because, in order to create an image of the future, past events are utilized to construct images of future novel situations. Neuroimaging research indicates that engaging in EFT activates areas of the brain associated with executive control necessary to plan and guide behaviors (Szpunar et al., 2007). As a result, engaging in EFT may function as a way of improving top-down control of executive functioning necessary to regulate impulse control problems.

Recent research has demonstrated that engaging in EFT during intertemporal decision making can reduce the bias toward immediate gratification that is characteristic of individuals who engage in impulsive behavior (Benoit et al., 2011; Daniel et al., 2013a, 2013b; Lin & Epstein, 2014; Peters & Büchel, 2010). Early studies to demonstrate this effect were conducted

within the context of neuroimaging studies (Benoit et al., 2011; Peters & Büchel, 2010). The first of such studies (Peters & Büchel, 2010) demonstrated that cueing autobiographical episodic thought during a delay discounting task reduces discounting. In the study, participants were interviewed to generate seven future events the participant had planned in the upcoming seven months. Cues for these future events were then utilized during half of the trials of a delay discounting paradigm (the other half of trials were uncued), completed while participants were in an fMRI scanner. Researchers found that discounting rates were lower in the cued condition and that, for the cued condition only, a significant decrease in discounting was observed. Although the results of this study indicated positive results relative to a no-manipulation control, Benoit, Gilbert, and Burgess (2011) demonstrated that the same effect could be obtained using an active comparison condition. They randomized participants either to imagine a future situation in which they would spend the hypothetical money being considered in the delay discounting task or simply estimate what could be purchased with that amount of money (comparison condition). Results showed that the condition in which participants engaged in episodic thinking was associated with attenuation in temporal discounting not observed in the control condition.

Although the Benoit paper included this active control, more recent studies have included comparison conditions in which non-future episodic thinking is controlled. Daniel, Stanton, and Epstein (Daniel et al., 2013b) randomized overweight and obese participants to either a condition in which they engaged in EFT using vividly imagined positive events at specific times in the future or a condition in which they engaged in episodic thinking using vividly imagined positive recent events gleaned from reading a travel blog. The results of the study found that engaging in EFT reduced discounting as well as ad libitium eating behaviors. A similar study (Daniel et al., 2013a) utilized a within-subject design to compare engaging in EFT to imagining parts of a

vivid story participants read to themselves and found that both obese and normal-weight participants reduced their temporal discounting after engaging in EFT, ruling out between subjects factors as explanations for the observed effects of EFT.

More recent studies have utilized control conditions that control for autobiographical thinking by asking control participants to imagine positive events from the very near future (e.g., within the next 24 hours; Daniel et al., 2016; Lin & Epstein, 2014) or very recent past (e.g., within the past 24 hours; Daniel et al., 2016; Snider et al., 2016; Stein et al., 2016). Such studies demonstrate significant effects of EFT on delay discounting, suggesting the impact of EFT cannot be attributed to autobiographical thought and may be better explained by extending the temporal window.

Given that engaging in EFT activates areas of the brain associated with episodic memory, it may be reasonable to assert that vividly imagining positive distal memories could yield similar effects to EFT. Daniel et al. (2016) included three episodic thinking conditions: prospection, in which participants engaged in EFT for events occurring in 1 day, 2 days, 1 week, 2 weeks, 1 month, and 6 months; retrospection, in which participants were asked to vividly positive recall events from the past at the same time periods as the prospective condition; and control recent thinking, in which participants were asked to imagine positive autobiographical events from the past 24 hours and future 24 hours. They found that prospection was associated with significantly less future delay discounting relative to control, whereas retrospection was associated with less past discounting (namely, the devaluation of rewards in the distal past relative to rewards in the recent past) relative to control. The findings suggested that past and future episodic thinking affect temporal valuations differentially.

Very recent studies have extended EFT research to substance use disorders (Snider et al., 2016; Stein et al., 2016). Snider, LaConte, and Bickel (2016) examined 50 participants meeting criteria for alcohol use disorder and randomized them to either an EFT or recent past condition. Researchers demonstrated that EFT increased the valuation of future hypothetical monetary rewards relative to control. Additionally, researchers found significant differences between conditions in alcohol demand intensity, such that those in the EFT condition had reduced alcohol demand. Although no known studies have demonstrated that EFT impacts actual alcohol use, Stein and collegues (2016) evaluated EFT in a sample of smokers and demonstrated that EFT reduced discounting as well as the number of cigarette puffs during a task involving the self-administration of cigarettes.

In sum, although change expectancies are typically poor predictors of outcomes, this lack of prediction is understandable when considered in conjunction with insights from behavioral economics that indicate the diminished value of delayed and uncertain reinforcers. A new area of research seeks to improve the valuation of temporally distant rewards by engaging in cognition involving vivid imagination of feasible positive events in the future. Recent studies have demonstrated that such interventions are effective in populations with substance use disorder pathology.

Study Significance

The present study will build upon these recent findings indicating that EFT can reduce temporal discounting and substance use. The present study will seek to expand upon the present literature in a variety of ways. First, the study will seek to replicate findings that an EFT manipulation reduces delay discounting and associated outcomes within a previously unstudied sample of at-risk college student drinkers. Additionally, the present study will improve upon the

methods of between-condition EFT research by controlling for pre-manipulation delay discounting in order to examine differences in the unique variance in delay discounting following intervention. The study will also relate the effects of EFT to measures of alcohol use intentions and self-reported alcohol use in addition to testing its effects of a delayed discounting task. The duration of the EFT manipulation on delay discounting will be examined one week after the manipulation. Finally, the study will examine whether traditional change expectancies measured following the EFT manipulation are better predictors of future alcohol use than change expectancies measured under control conditions. It might be expected that change expectancies would become better predictors of future behaviors if the future could be made more salient through the use of EFT.

The present study tested the following hypotheses:

1) Participants randomized to EFT will reduce their delay discounting relative to the comparison conditions.
2) The effect of EFT on discounting will be observed, a week or more following the intervention.
3) Participants randomized to EFT will demonstrate differences in other outcomes including alcohol demand intensity, intentions to use alcohol, and alcohol use frequency, relative to those randomized to the comparison conditions.
4) Change expectancies will be more strongly associated with alcohol use following the manipulation for those in the EFT condition, compared to participants in the comparison conditions.

Methods

Participants

College student participants from Virginia Tech were recruited via an online extra-credit system, emails to undergraduate listservs, poster advertisements, and presentations in undergraduate psychology courses (See Appendix A for recruitment materials). Alcohol-using undergraduates at least 18-years of age who were not current students of this investigator were invited to complete an online screening survey to determine eligibility for the remainder of the study. Of the 926 participants who completed the screening, 459 were eligible and invited to participate in the second phase of the study, which consisted of an in-lab session and online follow-up one week later. Participants were excluded for the following reasons: obtained score less than 8 on the Alcohol Use Disorders Identification Test (*n*=454), responded inappropriately to items assess vigilance (See self-report accuracy and vigilance section; *n*=44), or provided an affirmative response to survey item assessing participant perception that self-reported data was inaccurate (See self-report accuracy and vigilance section; *n*=2). A total of 138 participants attended the in-lab session and were randomized to condition. Of those, 10 were excluded from analyses due to failure to meet delay discounting consistency criterion (See preliminary analysis section of results), resulting in an effective sample size of 128 participants. The follow-up survey was completed by 86% of those participants (*n*=110). Participants had an average age of 19.92 (sd=2.81) and were primarily female (74%), white (81%) and non-Hispanic (95%). Additional demographic data and sample characteristics are provided in Table 1.

Procedures were approved by the Virginia Tech Institutional Review Board (Project #15-420). Participants provided consent via electronic signature and signed consent forms for the

online screening and second phase of the study, respectively (See Appendix B for consent forms). Participants were compensated for participation as follows: for screening questionnaire, 1 SONA extra credit point or entry into a raffle for one of two $50 Amazon gift cards; for in-lab session, 2 SONA extra credit points or $10 Amazon gift card; and for follow-up, 1 SONA extra credit point or $5 Amazon gift card.

Experimental Conditions

Participants were assigned randomly to one of three conditions: Episodic Future Thinking (EFT; *n*=43), Episodic Past Thinking (EPT; *n*=43), and Control Episodic Thinking (CET; *n*=42). In EFT, participants were asked to imagine positive anticipated events 1 week, 1 month, 6 months, 1 year, and 5 years into the future. Conversely, participants in EPT were asked to imagine positive past events during the same time intervals. CET participants were asked to read entries from a travel blog and then recall positive events which occurred within the narrative. Protocols for each condition are provided in Appendix C.

Measures

All assessments were completed directly by participants in Qualtrics (Copyright 2015), with the exception of the Episodic Thinking Form (ET Form; see appendix D) which was recorded on a paper form and then later entered into Qualtrics by research assistants. Measures included in the present analyses will be described within this section. Complete list of measures administered at each timepoint can be found within the procedures section.

Affect. The Positive and Negative Affect Scale (PANAS; Watson, Clark, & Tellegen, 1988) was used to assess state affect following experimental manipulation. The 20-item measure yields two subscales, one for positive (PA) and one for negative affect (NA). Subscale scores

may range from 10 to 50, with scores closer to 50 indicating greater affect intensity. Both scales exhibited good internal consistency (PA α=.88; NA α=.83).

Alcohol demand. Alcohol Demand was assessed using the Alcohol Purchase Task (APT; Jacobs & Bickel, 1999; Murphy & MacKillop, 2006). In the present version of the APT, participants were asked to indicate how much alcohol they would likely consume under conditions of varying drink costs, ranging from $0 per drink to $9 per drink. A recent meta-analysis demonstrated support for the construct validity of the APT (Kiselica et al., 2016). The APT may yield metrics including breakpoint (the earliest price at which consumption is zero), intensity (consumption of alcohol at the lowest price), and demand elasticity (a measure of change in consumption as a function of price, or price sensitivity). Intensity was chosen as an outcome variable of interest, as recent research has demonstrated that intensity yields the strongest effect sizes in the prediction of alcohol-related outcomes, measured concurrently (Kiselica et al., 2016) as well as prospectively (Dennhardt, Yurasek, & Murphy, 2015).

Alcohol use disorder risk. The Alcohol Use Disorders Identification Test (AUDIT; Babor, De La Fuente, Saunders, & Grant, 1989) was be used to identify participants at risk of an alcohol use disorder. The AUDIT was developed by the World Health Organization as a brief measure to gauge risk of alcohol use disorders. The 10-item measure was validated for use among college students and exhibits good internal consistency (α=.80) and predictive validity (Fleming, Barry, & Macdonald, 1991; Kokotailo et al., 2004). A study utilizing a large college student sample estimated AUDIT sensitivity at .82 and specificity at .78 when utilizing a cut-off of 8 (Kokotailo et al., 2004). The wording of item 3 was changed to be more consistent with standard drinks in the United States, in that a binge drinking episode was defined as 5 or more

drinks for males and 4 or more drinks for females, rather than 6 or more drinks (c.f., Kokotailo et al., 2004).

Alcohol use and intentions. Alcohol use and intentions were assessed using a variation of the Daily Drinking Questionnaire (DDQ; Collins, Parks, & Marlatt, 1985; Kruse, Fromme, & Corbin, 2005). The DDQ was designed to function as a self-report version of the timeline follow-back (Sobell & Sobell, 1992), in that participants are prompted to consider events from the time period prior to entering estimations of alcohol consumption into a calendar. At screening, participants were asked to estimate number the drinks consumed in a typical week during the preceding 30 days. At the in-lab and follow-up assessments, participants were asked to estimate the number of drinks consumed during the preceding 7 days (See Appendix E). Reported drinks were summed to estimate total drinks per week.

The DDQ was modified to assess alcohol use intentions (See Appendix E) by asking participants to report how many drinks they anticipated consuming in the upcoming 7 days. A sum of this data was used to estimate total intended drinks per week.

Change expectancies. Outcome expectancies regarding changing alcohol use were assessed using the Excessive Drinker Outcome Expectations (EDOES; Rollnick et al., 1996). The EDOES assesses perceptions of 12 different potential outcomes of change and prompts participants to indicate the importance of potential outcomes (e.g., *How important is it to you to be able to relax?*) on a scale of 1 (very important) to 4 (very unimportant). The measure also asks participants to indicate agreement with statements regarding how reducing alcohol use would improve the outcome (e.g., *If I cut down my drinking, I will be more able to relax.*) and statements regarding how maintaining current alcohol use would improve the outcome (e.g., *If I*

drink my usual amount, I will be more able to relax.), using a scale of 1 (strongly agree) to 5 (strongly disagree). Each item was scored by taking the difference between ratings regarding reduced use and maintained use, and then multiplying this difference by the rating of outcome importance, which was reverse scored. The resulting score, which may range from -16 to 16, indicates positive expectancies for reduced drinking if high and negative expectations of reduced use if low. A mean score calculated from all EDOES items yielded good internal consistency (α=.79).

Delay discounting. A titrating delay discounting task was used to estimate indifference points in the discounting of a hypothetical monetary reward of $100 at delays of 1 week, 1 month, 6 months, 1 year, and 5 years. A 6-choice trial titrating procedure wherein participants were presented with a choice between receiving a "smaller-sooner" hypothetical monetary reward immediately (e.g., "$50 today) or a "larger-later" monetary reward of $100 at a later time. For each time delay (1 week, 1 month, 6 months, 1 year, and 5 years), participants were initially asked to choose between $50 today and $100 at the time of the delay. In subsequent trials, $100 at the time of delay was held constant while the choices for the smaller-sooner rewards varied depending on participant response. The value of the smaller-sooner choice was decreased when the smaller-sooner choice was selected in the previous trial and increased when the larger-later was selected in the previous trial. The magnitude of the increase/decrease in the smaller-sooner choice was diminished by 50% for each subsequent trial, such that the increase/decrease of the smaller-sooner choice was $25 in trial 2 (i.e., participants were presented with a smaller-sooner choice of $25 or $75 in trial 2, depending on their response to trial 1.), $12.50 in trial 3, $6.25 in trial 4, and so on. After 6 of these titrating trials associated with a particular delay (1 week, 1 month, 6 months, 1 year, or 5 years), the resulting value was

retained as an estimate of the value at which an immediate monetary reward is roughly equal to $100 at the given delay (i.e., indifference point).

Area under the curve (AUC), used as the primary measurement of delay discounting, was calculated based on all five estimated indifference points as described by Myerson, Green, and Warusawitharana (2001). Within the AUC calculation, delays are standardized relative to the longest delay and monetary rewards standardized relative to the largest amount of money, resulting in AUC values which can be compared across studies. This standardized AUC may range from 0 to 1, with smaller values indicating a steeper empirically-observed discounting curve, indicating greater temporal discounting.

At the in-lab session only, delay discounting questions were presented with idiographic cue words associated with episodic events appropriate to experimental condition. See procedures for additional detail regarding the nature and presentation of cue words. An example of the presentation of a cued delay discounting question is presented in Appendix F. When the delay discounting task was administered at screening and follow-up, question text was presented without ideographic cue words (this traditional administration of delay discounting is hereafter referred to as "uncued delay discounting").

Episodic event valence. The ET Form was used to record ratings of episodic events listed during the experimental manipulation. Consistent with previous EFT research (Daniel et al., 2013a, 2013b; Snider et al., 2016), participants were asked to rate each event in terms of importance, enjoyment, excitement, and vividness on a Likert scale from 1 (not at all) to 5 (very much).

Self-report vigilance and accuracy. Online questionnaires administered outside of the laboratory contained two types of questions designed to assess vigilance and accuracy of self-reporting. Vigilance questions prompted participants to select a particular response to a given question (e.g., "Please select 'Never'."). An accuracy question, which was administered at the end of the screening and follow-up surveys, prompted participants to determine whether their responses were accurate and appropriate for analysis. This item text read as follows: "In your honest opinion, should we use your data for this study (i.e., did you pay attention, read the items, and respond honestly)?" If participants responded to the question affirmatively, they were prompted to indicate a reason their data should be excluded (e.g., "I didn't read the questions."; "I didn't answer honestly."). The responses of participants who indicated that their data should be excluded for non-accuracy related issues (e.g., "I'm not the type of alcohol user you're looking for." and "I don't want to participant in phase 2 of this study.") were recoded.

Procedures

Online screening. Eligible undergraduates self-referred to the online screening questionnaire, which took approximately 45 minutes to complete. Prior to answering any questions, participants were prompted to review a consent form and provide an electronic signature, as evidence voluntary consent to participate in the screening questionnaire. The following measures were used in the online screening (listed in order of appearance): demographic items (age, sex, race, marital status, employment status, and year in school), AUDIT, DDQ (average week), uncued delay discounting task (in contrast with a cued delay discounting task conducted during the in-lab session and described in following section), Rutgers Alcohol Problems Scale, Readiness to Change Questionnaire, and a stage of change algorithm.

Participants meeting eligibility criteria were invited to phase II of the study, which consisted of an in-lab experimental session and an online follow-up survey, administered one week later.

In-lab session. Participants eligible for phase II of the study were invited via email to sign-up for an in-lab session on the online extra credit website (see Appendix D for email correspondence). A copy of the Phase II consent form was attached to the email in order to provide additional information to potential Phase II participants. The in-lab appointment was conducted in a private room. At the outset of the in-lab session, the experimenter reviewed the Phase II consent form. Participants were provided with time to review the consent form and ask questions prior to choosing to sign. All participants were offered a paper copy of the consent form for their records. Following obtaining consent, participants were randomized to condition. Although participants were allotted up to 90 minutes for completion of the in-lab session, it was very unusual for the appointment to last longer than an hour.

Prior to experimental manipulation, participants were asked to report on recent alcohol use during the past week using the Daily Drinking Questionnaire (DDQ). Participants were then engaged in the experimental manipulation associated with the condition to which they were randomized. The experimenter elicited episodic events using provided prompts in accordance with condition. For the EFT condition, participants were asked to imagine positive events to which they look forward at specific times in the future (1 week, 1 month, 6 months, 1 year, and 5 years into the future). Participants were provided with dates to anchor responses within a temporal window for each time point (e.g., "What are some positive events you can imagine happening about a week from now? Consider between 3 and 7 days from now, or between Friday November 6th and Monday November 10th."). Participants were instructed that the positive events should be ones in which they anticipate being personally involved, rather than general

positive events happening in the world or their environment. Additionally, directions specified that events should be ones that could reasonably occur, but that participants need not be certain that they will occur in the future. Directions for the EPT condition were largely the same as the EFT condition, except that participants were instructed to recall positive events from specific times in the past (1 week, 1 month, 6 months, 1 year, and 5 years into the past). EPT participants were provided with specific dates to anchor responses in the same fashion as the EFT condition. They were also instructed that the events should be autobiographical in nature. Finally, participants in the CET condition were instructed that they would be asked to read a travel blog and recall at least 5 events from what they had read. Participants were provided with time to review a series of entries from a travel blog. After participants indicated that they had finished reading, they were asked to describe as many events from the blog entries as they could recall.

During the episodic event elicitation process up to 3 events per time period (or up to 15 events in sum for the CET condition) were recorded by the experimenter using the ET Form. The experimenter then obtained importance, enjoyment, excitement, and vividness ratings for each event. Following this rating process, participants were asked to describe the event in order to assess whether the participant was engaging in autobiographical thinking. Participants in EFT and EPT conditions who did not evidence the use of autobiographical thinking were prompted to so by asking them to imagine themselves in the event and provide a description of what they are thinking, feeling, and doing. Although no questions regarding alcohol use within events were administered, the ET form included a field for the experimenter to note whether the participant mentioned alcohol in his or her description of the imagined event.

Following the completion of ratings, the experimenter selected the five most vividly imagined events for CET and the most vividly imagined event at each time period for the EFT

and EPT conditions. Finally, the experimenter asked the participant to generate a concise cue word or phrase to be used in the subsequent experimental tasks. For example, a participant in the EFT condition might use the word "championship" as a cue to imagine his or her experience winning the state championship in baseball as a high school student. A participant in the CET condition might utilize the phrase "spice market" as a cue to imagine the character's son interacting with a man at a spice market. The experimenter then excused the participant for a short break while she input each cue into appropriate Qualtrics fields. This updated Qualtrics assessment, which included ideographic cues, was used to administer the remainder of the in-lab tasks and questionnaires. Cue words were displayed in two ways during the survey: as prompts to engage in episodic thinking (See Appendix G) and as temporal cues during the delay discounting procedure (See Appendix F). When displayed as prompts to engage in episodic thinking, the cue word was presented on screen with a direction to "Take a minute to imagine the event below." Participants in the EFT and EPT conditions were further prompted to imagine where and when the event occurs, as well as what they are doing and feeling during the event ("Imagine the time, the place, what you'll be doing, and how you'll be feeling"). When displayed as temporal cues during the delay discounting task, the cue word was simply displayed above the question text ("Which would you prefer?") for each titrating trial. Because there were 6 trials for each time period, these cues were displayed 6 times in a row for each participant. For participants in the EFT and EPT conditions, cues were presented in accordance with the delay for the larger-later reward (e.g., the cue word associated with an event 5 years from now would be displayed while the participant chooses which amount of money he or she would prefer: smaller amount of money today or $100 5 years from now). For example, if a participant in the EFT condition had a cue word of "graduation" (associated with graduating with a Master's degree in

about five years), he would see the word “Graduation” in two ways: (a) on screens with directions prompting him vividly imagine “Graduation” and second, and (b) above question text asking him to choose between a smaller amount of money today or $100 in five years.

Prior to beginning the questionnaires, the participant was provided with brief instruction by the experimenter to complete the computerized assessment by attending to on-screen directions and engaging in episodic thinking when presented with a prompt screen. Measures and episodic thinking prompts were presented to participants in the following order: 1-week episodic thinking prompt and cued delay discounting, 1-month episodic thinking prompt and cued delay discounting, 6-month episodic thinking prompt and cued delay discounting, 1-year episodic thinking prompt and cued delay discounting, 5-year episodic thinking prompt and cued delay discounting, PANAS (state affect), all episodic thinking prompts (presented individually, in chronological order), APT (alcohol demand), EDOES (change expectancies), Brief Situational Confidence Questionnaire (BSCQ), DDQ (alcohol use intentions), and questions assessing intentions to engage in alcohol change-related behaviors.

Although participants completed assessments independently and in privacy, the experimenter remained present in order to answer any emergent questions. Following completion of assessment materials, participants were thanked for participation and verbally reminded that they would be emailed a link to the follow-up survey in one week.

Online follow-up. Participants were emailed a link to the online follow-up 7 days after their in-lab sessions. Participants had up to 10 days to complete the follow-up. Up to 4 text message and/or email reminders were sent prior to deadline. The follow-up survey included the following assessments (listed in order of presentation): DDQ (past week alcohol use), uncued

delay discounting, APT (alcohol demand), EDOES (change expectancies), BSCQ (self-efficacy), DDQ (alcohol use intentions), and questions assessing intentions to engage in alcohol change-related behaviors. Delay discounting choices were presented "uncued" (without ideographic cues words associated with episodic events used in the experimental manipulation) at follow-up in order to assess whether differences among conditions were sustained in absence of additional intervention. Because participants were primed to engage in episodic thinking when presented with cue words during the in-lab manipulation, presenting the same cues at follow-up could be considered an additional dose of the experimental manipulation. As such, no episodic thinking prompts or delay discounting cues were presented within the follow-up assessment. The follow-up required about 45 minutes to complete.

Results

Preliminary Analyses

Data exclusion. Participants' responses to vigilance and accuracy items were examined to determine appropriateness for analysis. As noted previously, participants evidencing inattentive or inaccurate responding at screening were not invited to participate in the second phase of the study. Although self-report accuracy and vigilance items were included within the online follow-up survey, no responses evidencing inaccuracy or non-vigilance were identified at follow-up. In sum, no data associated with the randomized sample was excluded from analysis due to vigilance or accuracy items.

An algorithm was used to identify instances of non-systematic responding during the delay discounting task administered within the online screening (Johnson & Bickel, 2008; Snider et al., 2016). The algorithm utilized two criteria to assess non-systematic responding. Criterion 1

was violated if any the indifference point was more than 20% greater than the preceding indifference point. No participants violated criterion 1 more than once; as such, no data was excluded from analysis as a result of Criterion 1. Criterion 2 was violated if the indifference point associated with a 5-year delay was less than 10% smaller than indifference point associated with a 1-week delay (i.e., if the participant demonstrated little to no discounting despite a significant increase in temporal delay). Ten participants violated criterion 2 and were excluded from analyses, resulting in an effective sample size of 128. Descriptive statistics for demographic variables of the effective sample are displayed in Table 1.

Randomization. The effectiveness of randomization was examined by comparing treatment conditions on demographic variables and relevant variables, as measured at screening (delay discounting, AUDIT score, total drinks in typical week). Chi-square analyses were used for categorical variables and analysis of variance (ANOVA) was used for continuous variables. No significant differences between conditions emerged, suggesting that randomization was effective in producing random independent samples. Descriptive statistics for variables of interest by condition are displayed in Table 1.

Attrition. The online follow-up was completed by 86% of participants within the effective sample (n=110). Attriters were compared to non-attriters using chi-square analyses for categorical variables and ANOVA for continuous variables. No evidence of differential attrition by condition was found. Additionally, attriters did not differ significantly from non-attriters on demographic variables or outcome variables, as measured at screening.

Episodic event valence. ANOVA analyses were used to examine differences among conditions in ratings of importance, excitement, enjoyment, and vividness. Results demonstrated

significant between condition differences for all ratings, such that EPT and EFT conditions demonstrate higher ratings, relative to the CET condition (See Table 2 for descriptive statistics). Bivariate correlations were used to examine relationships between valence ratings and outcomes of interest. None of the episodic event valence scales were significantly associated with dependent variables of interest in the present investigation.

Affect. Given that affect is associated with cognitive processes (e.g., working memory and inhibitory control) which may mediate episodic future thinking (Lin & Epstein, 2014; Rowe, Hirsh, & Anderson, 2007), ANOVA analyses were conducted to examine differences among conditions on state affect (PANAS) scales immediately following the experimental manipulation. No significant differences in affect among conditions were observed.

Alcohol-related events. Alcohol was explicitly mentioned during a small minority of events. A total of 15 events were recorded as explicitly involving alcohol, representing 2% of total events listed. A chi-square analysis was used to compare the EFT and EPT conditions on whether an alcohol-related event was listed by a participant. No significant differences by condition were observed; however, given the small expected values, these results may not be meaningful.

Hypothesis Tests

The first hypothesis predicted that the EFT condition would produce less temporal discounting in a cued delay discounting task, relative to the comparison condition. One-way analysis of covariance (ANCOVA) was conducted to determine statistically significant differences among conditions in the delay discounting area under the curve (AUC), as measured at in-lab session, controlling for AUC, as measured at screening. Significant differences in AUC

among groups were demonstrated, with post-hoc analyses demonstrating significantly less AUC (indicating greater discounting) in CET relative to both EFT and EPT (See Table 3 and Figure 1). EFT and EPT did not significantly differ. To explore the nature of this difference in AUC, ANCOVAs for individual indifference points were conducted, controlling for pre-intervention AUC. These results suggested that significant differences among conditions did not emerge until the 1-year delay, with post-hoc tests demonstrating less discounting in EFT and EPT relative to CET at 1 year and less discounting in EFT relative to EPT and CET at 5 years (See Table 3 and Figure 2).

The second hypothesis was that the EFT condition would continue to demonstrate less delay discounting, relative to CET, when measured using an uncued delay discounting task one week after the in-lab session. The previous analysis was repeated with delay discounting data from the online follow-up to evaluate the second hypothesis. An ANCOVA was conducted to determine statistically significant differences between conditions in AUC, as measured at the online follow-up, controlling for AUC, as measured at screening. Significant differences between groups were demonstrated, with post-hoc analyses demonstrating significantly less AUC in EFT relative to both EPT and CET (See Table 3 and Figure 3). ANCOVAs for individual indifference points were conducted, controlling for AUC at screening. These indifference point results demonstrated significant differences among conditions only at 1 week, such that EFT demonstrates less discounting than CET, but no difference from EPT (see Table 3 and Figure 4).

To examine the hypotheses that EFT would result in lower alcohol demand intensity, alcohol use intentions, and alcohol use frequency than comparison conditions, one-way analyses of covariance (ANCOVA) were conducted to determine statistically significant differences

among conditions outcome variables of interest including alcohol demand intensity, alcohol use intentions, and post-intervention alcohol use (as assessed during online follow-up), controlling for AUC, as measured at screening. ANCOVAs for demand intensity and alcohol use intentions yielded non-significant differences among conditions. Descriptive statistics for demand intensity, alcohol use intentions, and alcohol use are displayed by condition in table 4. Significant differences among conditions were observed, however, in alcohol use frequency (past 7 days), $F(2,106) = 3.57$, $p<.05$ such that alcohol use was lower in the EFT condition relative to the EPT ($p=.04$) and CET ($p=.01$). When the ANCOVA was repeated with the additional covariate of pre-intervention alcohol use, non-significant overall results were observed, $F(2,105) = 2.62$, $p=.08$; however, posthoc significance analyses indicated significant differences between EFT and EPT ($p=.03$), such that alcohol use remained lower in the EFT condition.

To test the final hypothesis that EFT will moderate the relationship between outcome expectancies and use, a moderation analysis in which follow-up alcohol use frequency was regressed onto change expectancies reported during in-lab sessions following the manipulations, dummy-coded condition variables, and variables representing the interaction between condition and change expectancies was conducted. Interaction terms were created by multiplying mean-centered change expectancy scores by dummy-coded condition variables. Significant interactions were predicted in order to demonstrate that the relationship between and change expectancies and future alcohol use varied by experimental condition. However, the analysis resulted in non-significant main effects and interactions terms, failing to provide evidence of moderation.

Exploratory analyses regarding change expectancies demonstrated a significant relationship between change expectancies and alcohol use intentions measured at the in-lab session ($r=.22$, $p=.01$) and at the follow-up ($r=.22$, $p=.02$). Furthermore, alcohol use intentions

measured at the in-lab assessment predicted subsequent alcohol use, even after controlling for pre-manipulation alcohol use (r=.34, p<.01). Such a relationship may be supportive of a mediational model wherein change expectancies predict alcohol use intentions, which subsequently predict alcohol use. As such, a non-hypothesized moderated mediation model wherein the relationship between intentions and use is moderated by condition was tested. A model in which alcohol use was regressed onto alcohol intentions, dummy-coded condition variables, and the interactions between dummy-coded condition variables and alcohol intentions (interaction terms were created by multiplying mean-centered alcohol use intention variable by dummy codes for condition) yielded no significant interaction terms.

Discussion

The present investigation demonstrated the utility of a brief episodic future thinking manipulation, replicating previous findings and extending the current body of literature. The first hypothesis that episodic future thinking condition would predict lower rates of temporal discounting relative to both comparison conditions (control and past episodic thinking) was partially supported; however, unexpectedly, the episodic past condition also demonstrated lower rates of discounting relative to control, in contrast to a the results of recent study (Daniel et al., 2016). At the online follow-up, participants who were prompted to imagine future events demonstrated less discounting in an uncued discounting task relative to both control and past conditions, in support of the second hypothesis that the effects of the intervention would endure beyond one week. The third hypothesis that episodic future thinking would be associated with a variety of other outcomes including alcohol use intentions, alcohol demand intensity, and alcohol use yielded mixed results, with significant findings for use only alcohol use frequency (number

of drinks consumed in the past week). Finally, the fourth hypothesis that engaging in episodic future thinking would bolster the relationship between change expectancies and alcohol use was not supported, as no evidence for moderation was demonstrated. In sum, these findings lend support to the growing body of literature on the effects of prospective thinking on reduced delay discounting and associated impulsive behaviors.

The intent of the first hypothesis was largely to replicate previous findings that episodic future thinking is effective in reducing discounting (Daniel et al., 2016, 2013a, 2013b; Lin & Epstein, 2014; Stein et al., 2016) relative to control within a novel sample of at-risk college student drinkers. Consistent with previous studies, the EFT condition demonstrated improved valuation of delayed rewards relative to the control condition. Furthermore, when discounting at specific times was evaluated, differences between conditions emerged only at longer temporal delays, consistent with the results of Snider and colleagues (2016). This pattern suggests that distal events may serve as more salient cues regarding the value of delayed rewards. Notably, more distal future events are most likely to be associated with striving toward and achieving long-term goals. When looking one to five years into the future, many might imagine graduations or career success—such goals require delay of gratification. Increased salience of the benefits of delayed gratification may serve to explain the differential effects across timepoints. The demonstrated support of the first hypothesis adds to the growing body of literature that suggests the efficacy of prospective thinking in reducing impulsive decision-making.

The finding that past episodic thinking was associated with improved valuation of distal future rewards was inconsistent with a previous study which found non-significant differences between a past episodic condition and recent past/near future control on future discounting (Daniel et al., 2016). This discrepancy may be explained by a number of factors. First, the

present study controls for pre-manipulation delay discounting, which was not assessed in the previous study. In the present study, analyses conducted without controlling for temporal discounting, measured at screening, yielded non-significant differences among conditions. In addition to controlling for variability in discounting, the present study utilized a larger sample size, which may have enabled the detection of a significant difference of smaller magnitude. Finally, differences in control condition may explain the differential findings. Daniel and colleagues utilized a recent past/near future control condition in which participants were engaged in autobiographical thinking. In the present study, the control condition involves imagining events from the life of someone else and as such, does not involve autobiographical thought, whereas the episodic past condition does. Thus, the differences between the episodic past thinking condition and the control condition may be attributed to engagement in autobiographical thought, as opposed to distal episodic memory.

The second hypothesis that the effect of episodic future thinking on delay discounting would be observed in an uncued delay discounting task following a delay of at least a week was supported: after a delay of 7 to 17 days, participants in the EFT condition reported higher valuation of delayed rewards relative to both the control condition and the episodic past condition. This is the first known study to demonstrate an effect of episodic future thinking on uncued discounting, as well as the first known study to demonstrate an extended duration of the effect of episodic future thinking. These results are somewhat surprising given the brevity of the manipulation. Previous researchers have suggested that the duration of the EFT effect may need to be augmented via repetition at various intervals or via interventions such as working memory training (Snider et al., 2016). Although replication is necessary prior to drawing conclusions regarding substance use disorder treatments, these results certainly call for future longitudinal

EFT research. In contrast to the examination of indifference points at the in-lab session, where differences among conditions emerged at later timepoints, the only significant difference in indifference points at follow-up was between control and episodic future thinking at one week. Although there were significant differences observed between past and future thinking conditions on area under the curve at follow-up, there were no associated differences between the two conditions at any indifference point. It should be noted that area under the curve does not indicate the specific shape of a demand curve (i.e., two people may have the same area but two very different shaped curves). Thus, the difference may be explained by increased variability in the shape individuals' demand curves at follow-up.

Adding to the significance of the duration of the effect of EFT on discounting is the finding that engaging in EFT predicts less alcohol use, measured prospectively following intervention, compared to both control and episodic past conditions. This is the first known study to demonstrate significant effects of episodic future thinking alcohol use, measured prospectively. However, the finding is consistent with previous studies demonstrating that prospective thinking influences actual behavior, in addition to delay discounting (Daniel et al., 2013a; Stein et al., 2016). This finding, when considered in conjunction with the significant differences in favor of EFT on delay discounting at two timepoints, provides convergent evidence that EFT may be an important adjunctive procedure in treatments for substance use problems.

The episodic past condition yielded results better that control and commensurate with the EFT condition at the in-lab timepoint but poorer than EFT and commensurate with control at follow-up. The in-lab results are consistent with literature suggesting that a mechanism of prospective thinking involves retrospective autobiographical thought. Studies have demonstrated

that to imagine the future, we engage in a process of *episodic simulation* in which autobiographical memories are utilized in order to construct a novel future event in our mind (Schacter, Addis, & Buckner, 2008). Thus, similar neural pathways are engaged when one projects him or herself into the past or the future (Addis, Wong, & Schacter, 2007; Okuda et al., 2003). These shared pathways, referred to as the *core network*, may explain how retrospective episodic thought may reduce future discounting. The in-lab findings may be explained by the temporal attention hypothesis, which suggests that manipulating attention towards temporally distal events improves temporal decision-making (Radu, Yi, Bickel, Gross, & McClure, 2011). As such, projecting oneself far into the past may serve to direct attention away from immediate reinforcers, leading to less impulsive choices.

Despite the interesting finding that episodic past thinking reduces delay discounting relative to a non-autobiographical control, it should be noted that differences between the retrospective and control conditions were only observed within the cued delay discounting task and were not observed at follow-up with uncued delay discounting or alcohol use frequency. Furthermore, episodic future thinking demonstrated significant differences compared to past thinking at follow-up, both in respect to delay discounting, as well as actual use. Thus, neither of the above proposed mechanisms explain the present findings. Although the core network is implicated in both past and future episodic thinking, imaging studies have found differences in relative activation of specific regions of this network, finding greater activation in the frontopolar cortex and hippocampus when engaged in prospection, relative to retrospection (Schacter, 2012). In addition to neural differences in prospection, extending temporal distance into the future may be more salient to future decision-making involving delayed gratification than looking into the past, particularly within this young sample. When an 18-year old imagines events from 5 years in

the past, she is considering an event from early adolescence, which although positive in valence may or may not be associated with any delay in gratification. In contrast, when she projects 5 years into the future, she is more likely imagining herself having achieved long-terms goals, which were facilitated by delayed gratification. By making these distal, but important events salient, it is likely that the reinforcement value is increased. It follows that by increasing the salience and value of distal reinforcers, the relative value of immediate reinforcers in diminished and the cognitive control over impulsive decisions increased.

Despite the promising results for delay discounting and alcohol use, there were no differences between condition in alcohol use intentions or alcohol demand intensity. Notably, alcohol use intentions and demand intensity were not measured pre-manipulation and as such, the variance in these indices prior to manipulation was not controlled for, in contrast to analyses conducted for delay discounting and alcohol use. Although pre-manipulation use and problems were unrelated to condition, it is possible that pre-manipulation variance in these variables obscured differences between condition. The non-significant finding for demand intensity is inconsistent with the research of Snider and colleagues who found that demand intensity was decreased in the prospection condition. The lack of effect in the present study may be attributed to demographic differences, as the exclusively alcohol-dependent population had significantly greater alcohol demand than the present sample. Additionally, Snider and colleagues prompted participants to provide sensual details regarding future events, a direction which was not given in the protocol for the present study. Presuming that recalling sensual details improves the vividness with which an event is imagined, including this instruction likely produces more potent effects of an EFT intervention.

The final hypothesis regarding EFT as a moderator for the effect of outcome expectancies on alcohol use behaviors was not supported. Notably, the scale used to measure change expectancies was not validated among college students, but in a clinical population of alcohol using adults. Furthermore, change expectancies may be less relevant to college students who are more likely to "age out" of alcohol related problems. Despite these potential problems, exploratory analyses found that change expectancies predicted alcohol use intentions, which predicted subsequent alcohol use; however, the relationship between intentions and alcohol use was not moderated by condition.

The present study has a number of limitations. First, it includes a control condition which does not account for autobiographical thinking. Notably, the control condition yielded significantly lower ratings on likert scales of importance, vividness, excitement, and enjoyment relative to the other two conditions. However, these scale scores were not associated with results and did not change the findings when included in models as covariates. Additionally, given the inclusion of the past episodic thinking condition, which is autobiographical in nature, explanations of findings based on simply episodic or autobiographical thinking can be ruled out.

An additional limitation of the present study is the nature of the sample, which consists of at-risk college student drinkers. Although college students often represent a sample of convenience rather than a clinical population to be studied, the present sample may actually represent a strength of the study. First, given the rates of problematic alcohol use among college students, the at-risk college student population represents an important target for treatment. Additionally, the present sample, with an average age of 19, represents a younger sample than previous studies which utilized community samples with an average age of 25 or older (e.g., Daniel et al., 2016). Episodic thinking and the valuation of future rewards are regulated, at least

in part, by areas of the brain not fully developed until early adulthood (Galvan et al., 2006). Therefore, it is not unreasonable to assume that a young adult sample could respond differentially to intervention when compared to an adult sample. Very little episodic future thinking research on non-adult populations exists. However, one recent study found that vividness during episodic future thinking negatively correlated with delay discounting among adolescents (Bromberg, Wiehler, & Peters, 2015). Additional research on adolescents and young adults will be helpful in developing a more complete understanding regarding the development of this capacity and its effect on decision-making.

Minor procedural improvements may have strengthened the methods of the present study. First, ratings of importance, excitement, pleasantness, and vividness were obtained prior to providing participants with feedback regarding the effectiveness of their engagement in autobiographical thought. Ratings obtained following feedback would likely be more accurate. As noted previously, the episodic future thinking intervention may have been strengthened by including prompts to imagine sensory details of events.

Despite limitations, the present investigation demonstrates that engaging in prospective thinking in which the future is vividly imagined increased the value of delayed rewards and decreases alcohol use. These findings may important have implications for substance use disorder treatment. For instance, substance abuse treatments may benefit from goal elaboration in which the future consequences of reduced substance use are visualized and vividly imagined. This type of consideration of the future may serve to increase the salience of delayed reinforcers associated with moderate alcohol use or abstinence. By increasing the value of delayed rewards, individuals at risk for alcohol use disorder may be more likely to make choices that minimize negative consequences and improve long-term decision-making. Interventions based on episodic

future thinking may be useful supplements to existing empirically-validated treatments for substance use disorder and may help to inform the development of future novel interventions.

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Table 1

Descriptive Statistics for Demographic and Outcome-Related Variables, as Measured as Screening

	Total	EFT	EPT	CET
Age	19.92 (2.81)	19.88 (1.79)	19.72 (2.53)	20.17 (3.81)
Gender				
Male	33 (26%)	11 (26%)	13 (30%)	9 (21%)
Female	95 (74%)	32 (74%)	30 (70%)	33 (79%)
Race/Ethnicity				
Asian/Asian American	11 (8.6%)	6 (14%)	3 (7%)	2 (5%)
Black/African American	5 (4%)	1 (2%)	2 (5%)	2 (5%)
Hawaiian/Pacific Islander	2 (2%)	1 (2%)	0 (0%)	1 (2%)
White/Caucasian	103 (81%)	32 (74%)	36 (84%)	35 (83%)
Multi-Racial	5 (4%)	2 (5%)	2 (5%)	1 (2%)
Other	2 (2%)	1 (2%)	0 (0%)	1 (2%)
Outcome-related Variables				
AUDIT total	11.14 (3.16)	11.09 (3.15)	10.81 (3.10)	11.53 (3.26)
Delay Discounting (AUC)	0.35 (.23)	0.34 (.25)	0.34 (.22)	0.37 (.23)
Total drinks in average week	12.46 (6.31)	11.56 (6.28)	12.05 (6.09)	13.81 (6.48)
N	128	43	43	42

Note: Means and standard deviations are presented for continuous variables. Counts and within-group percentages are displayed for categorical variables. No significant differences were observed among conditions on any variable.

Table 2

Means and Standard Deviations of Episodic Thinking Valence Ratings

	Total	EFT	EPT	CET
Importance	4.07 (.74)	4.47 (.46)[a]	4.38 (.58)[a]	3.34 (.58)[b]
Enjoyment	4.28 (.57)	4.64 (.34)[a]	4.65 (.32)[a]	3.82 (.56)[b]
Excitement	4.20 (.69)	4.62 (.39)[a]	4.50 (.46)[a]	3.47 (.54)[b]
Vividness	4.05 (.72)	4.12 (.73)[a]	4.40 (.54)[a]	3.62 (.65)[b]
N	128	43	43	42

Note: Common superscripts (a, b) indicate non-significant mean differences at the .05 level.

Table 3

Means and Standard Deviations for Area Under the Curve and Indifference Points at In-Lab and Follow-Up Sessions.

	Total	EFT	EPT	CET
In-Lab				
Area Under the Curve	0.39 (.23)	0.41 (.25)[a]	0.39 (.23)[a]	0.35 (.22)[b]
Indifference Point				
1 week	86.40 (17.74)	87.48 (15.48)	86.82 (16.94)	84.85 (20.94)
1 month	71.93 (24.23)	72.55 (23.67)	73.38 (22.78)	69.93 (26.58)
6 months	50.18 (29.84)	54.02 (31.02)[a]	51.36 (30.00)[ab]	45.05 (28.40)[b]
1 year	45.78 (30.87)	52.49 (33.17)[a]	46.09 (30.54)[a]	38.58 (27.71)[b]
5 years	32.17 (29.49)	38.54 (35.24)[a]	29.41 (26.81)[ab]	28.46 (24.89)[b]
N	128	43	43	42
Follow-Up				
Area Under the Curve	0.46 (.28)	0.55 (.29)[a]	0.43 (.27)[b]	0.38 (.28)[b]
Indifference Point				
1 week	90.98 (14.47)	94.49 (6.89)[a]	92.30 (10.37)[ab]	86.13 (21.10)[b]
1 month	76.35 (22.73)	78.99 (18.39)	76.76 (23.77)	73.25 (25.79)
6 months	55.94 (27.05)	57.15 (28.66)	56.90 (27.67)	53.78 (25.37)
1 year	44.97 (29.02)	47.04 (30.01)	47.30 (30.17)	40.65 (27.12)
5 years	32.97 (28.98)	34.95 (32.33)	36.50 (28.97)	27.60 (25.09)
N	110	38	35	37

Note: Common superscripts (a, b) indicate non-significant mean differences at the .05 level.

Table 4

Descriptive Statistics for alcohol use, demand intensity, and alcohol use intentions at in-lab and follow-up sessions.

	Total	EFT	EPT	CET
In-Lab				
Number of drinks in past week	9.16 (7.72)	8.93 (8.67)	8.35 (6.45)	10.21 (7.96)
Demand Intensity	7.23 (2.91)	6.95 (2.74)	7.19 (2.59)	7.54 (3.39)
Alcohol use intention for following week	9.88 (6.70)	8.28 (5.53)	10.44 (6.26)	10.92 (7.96)
N	128	43	43	42
Follow-Up				
Number of drinks in past week	8.45 (7.63)	5.92 (6.82)[a]	9.17 (5.80)[b]	10.38 (9.26)[b]
Demand Intensity	7.38 (2.84)	7.29 (3.30)	7.37 (2.33)	7.49 (2.85)
Alcohol use intention for following week	9.26 (7.86)	8.63 (7.09)	9.49 (7.58)	9.70 (8.97)
N	110	38	35	37

Note: Common superscripts (a, b) indicate non-significant mean differences at the .05 level.

Figure 1

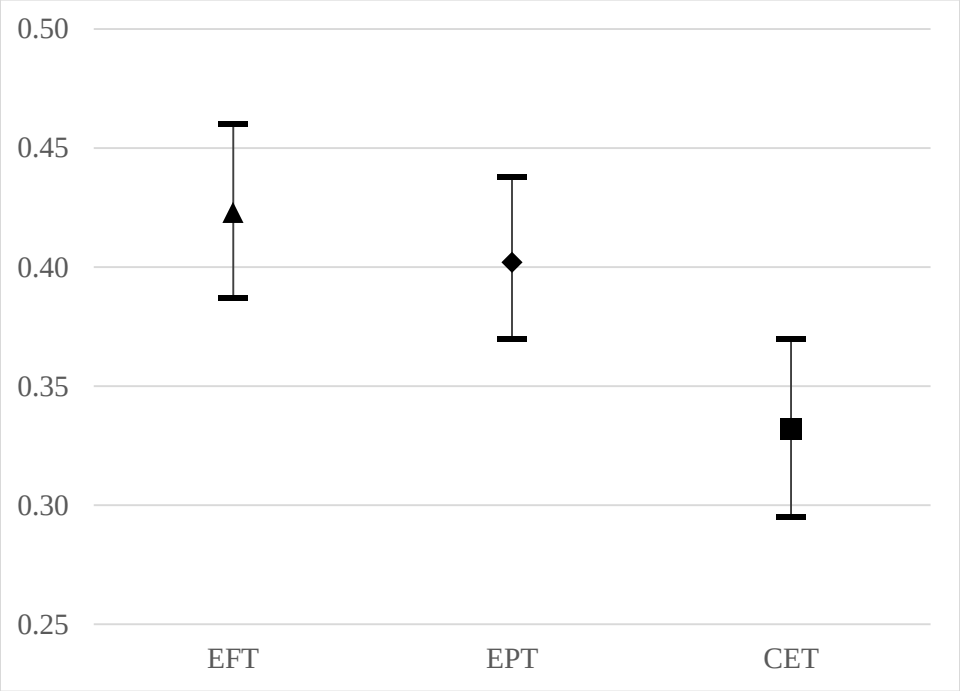


Figure 1. Point estimates and 95% confidence intervals for area under the curve, as measured at in-lab session.

Figure 2

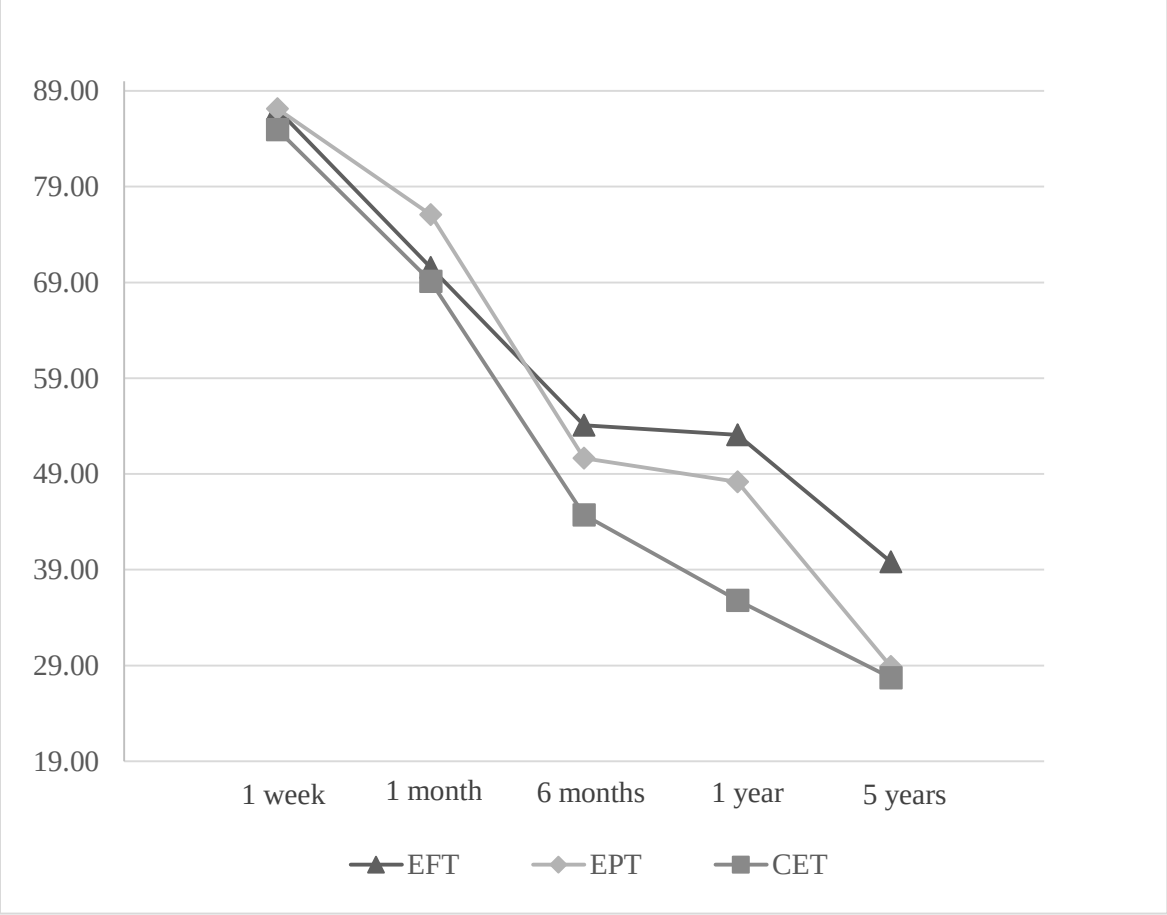


Figure 2. Point estimates of indifference points at delays of 1 week, 1 month, 6 months, 1 year, and 5 years, as measured at in-lab session.

Figure 3

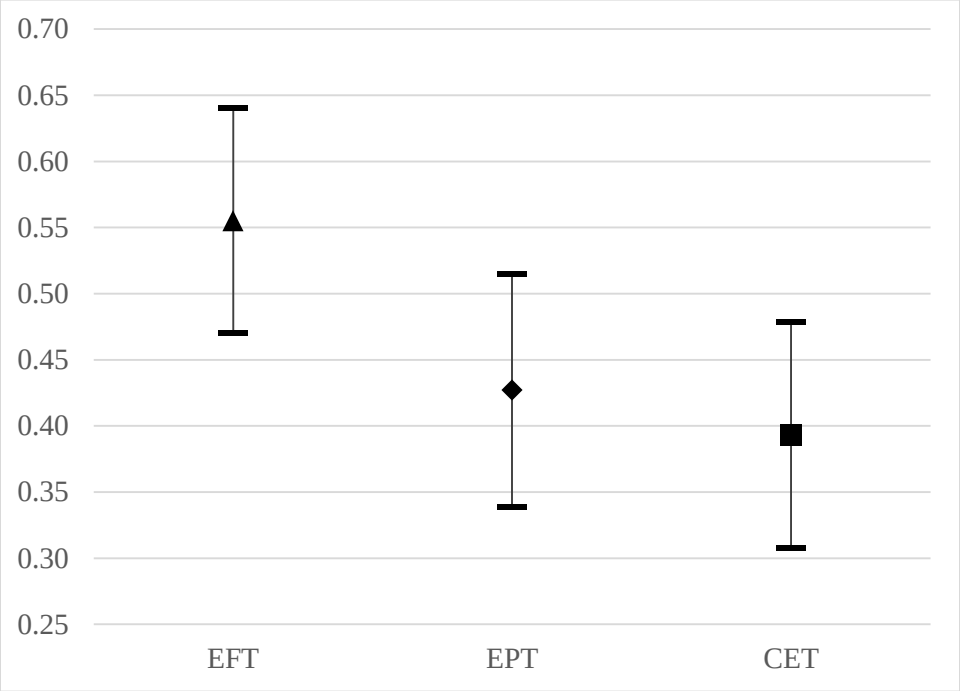


Figure 3. Point estimates and 95% confidence intervals for area under the curve, as measured at follow-up session.

Figure 4

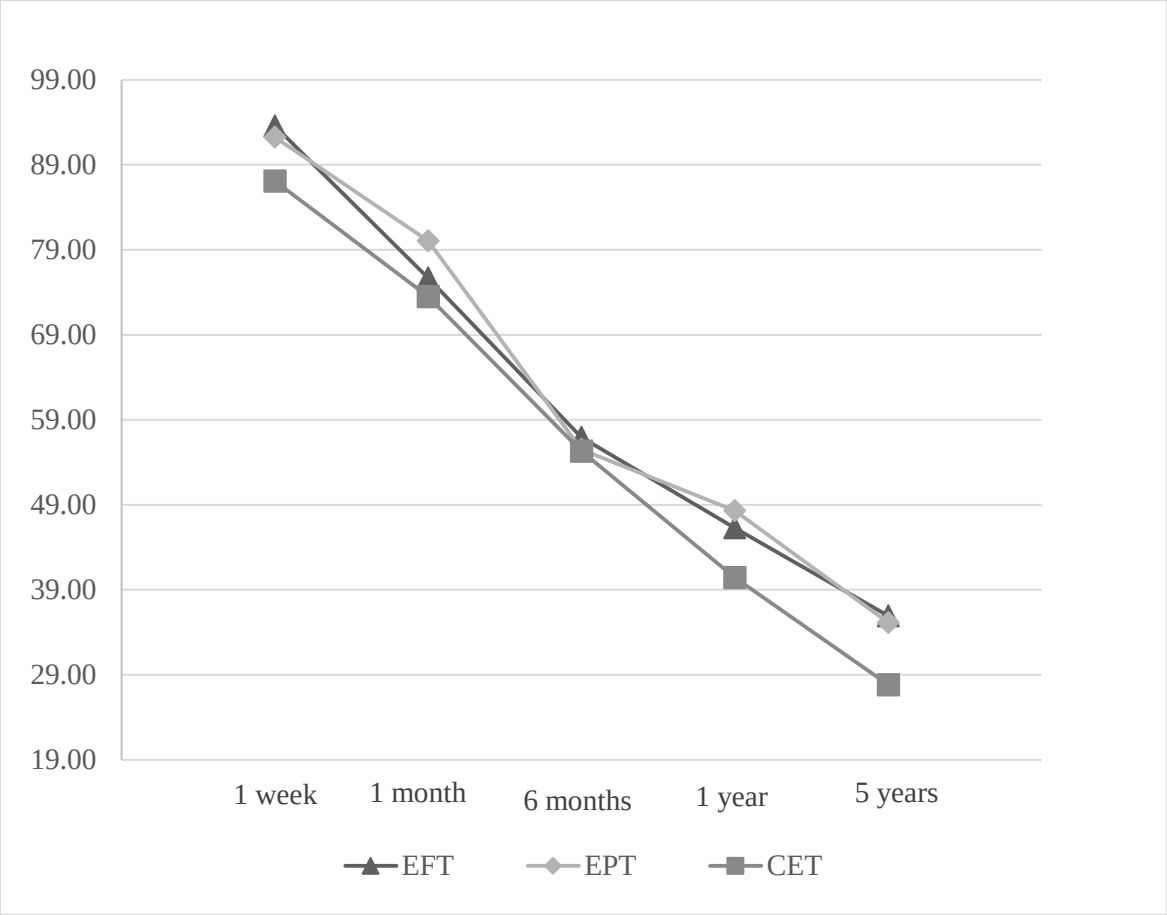
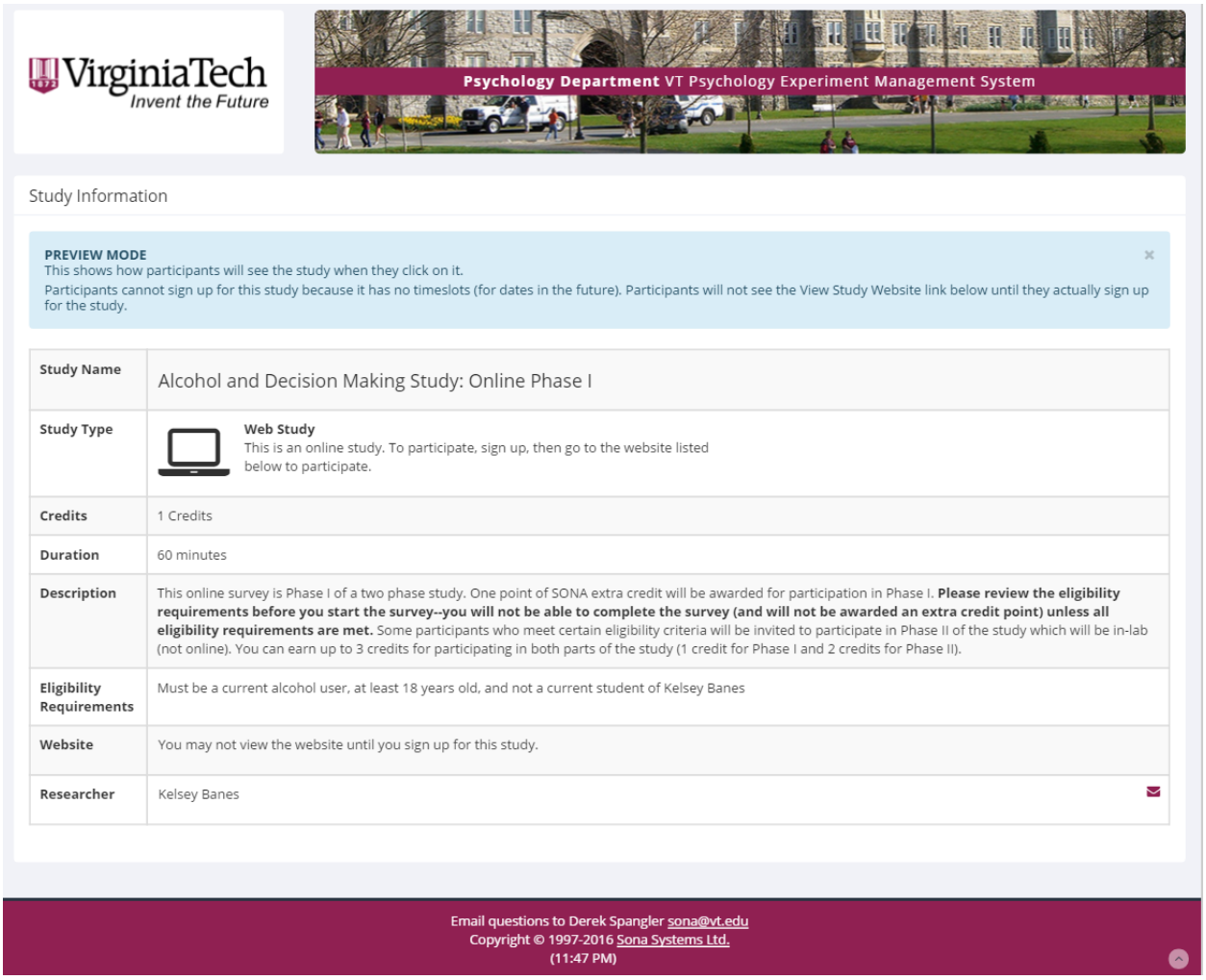


Figure 4. Point estimates of indifference points at delays of 1 week, 1 month, 6 months, 1 year, and 5 years, as measured at follow-up.

Appendix A

Extra Credit Website Advertisement



Undergraduate Listserve Email

The Addictions Research Laboratory at Virginia Tech is conducting a study titled *Alcohol and Decision Making*. The purpose of this research study is to develop a better understanding of how decision-making processes relate to alcohol use among college students. The data will be utilized in data analyses and publications aimed at better understanding decisions to use alcohol. Your participation in this study is voluntary and confidential.

This study has two phases, the first is an online survey and the second is a 75 minute in-lab session and online follow-up survey. For participating in both phases of the study, **you will receive 3.5 SONA credit hours or $15 in gift cards and entry into raffle for one of two $50 gift cards** (chances of winning approximately one in 25).

To be eligible for Phase I, the online survey, you must meet the following eligibility criteria: drink alcohol and be at least 18. The online survey will take approximately 30 minutes to complete. You will earn 0.5 SONA credit hours or raffle entry for a $50 gift card for participating in Phase I.

Depending on your responses during Phase I, you may be invited to participate in Phase II, an in-lab study and online follow-up. The in-lab study will take place in Williams 302 and will require about 75 minutes to complete. During the session, you will be asked to imagine different kinds of events and answer questionnaires. You will receive 2 SONA credit hours or a $10 gift card for participating in the in-lab session. A week after the in-lab session, you'll be emailed a link to an online follow-up survey. The survey will take approximately 45 minutes to complete. You will receive 1 SONA credit or a $5 gift card for completing the online follow-up.

To participate, please sign up for *Alcohol and Decision Making: Online Phase I* in SONA or follow this link: https://virginiatech.qualtrics.com/SE/?SID=SV_7TYfrvYiCam3z93.

Recruitment Presentation Script

My name _____ from the Addictions Research Laboratory at Virginia Tech. We are doing a study called *Alcohol and Decision Making*. The purpose of this study is to develop a better understanding of how decision-making processes relate to alcohol use among college students. The data will be used in data analyses and publications aimed at better understanding decisions to use alcohol. Your participation in this study is voluntary and confidential.

This study has two phases, the first is an online survey and the second is a 75 minute in-lab session and online follow-up survey. For participating in both phases of the study, **you will receive 3.5 SONA credit hours or $15 in gift cards and entry into raffle for one of two $50 gift cards** (chances of winning approximately one in 25).

To be eligible for Phase I, the online survey, you must drink alcohol, be at least 18, and not be a current student of Kelsey Banes. The online survey will take approximately 30 minutes to complete. You will earn 0.5 SONA credit hours or raffle entry for $50 gift cards for participating in Phase I.

Depending on your responses during Phase I, you may be invited to participate in Phase II, an in-lab study and online follow-up. The in-lab study will take place in Williams 302 and will require about 75 minutes to complete. During the session, you will be asked to imagine different kinds of events and answer questionnaires. You will receive 2 SONA credit hours or a $10 gift cards for participating in the in-lab session. A week after the in-lab session, you'll be emailed a link to an online follow-up survey. The survey will take approximately 45 minutes to complete. You will receive 1 SONA credit or a $5 gift card for completing the online follow-up.

Here are some flyers that will tell you where you can sign up for the study.

Poster Advertisement

Alcohol and Decision Making Study

Do you drink alcohol frequently?

Adult (18 years and older) volunteers needed for confidential study

- **Earn up to 3.5 SONA hours**
  - **or $15 in giftcards and $50 raffle entry (approximately 1 in 25 chance of winning)**
- **Log-in to SONA and look for Alcohol and Decision Making**
  - **Complete online survey for 0.5 SONA hours or raffle entry**
- **If eligible, you'll be invited to an in-lab session where you will be asked to and complete tasks and questionnaires on a computer (2 SONA hours or $10)**
  - **A week later, you'll be sent an online follow-up (1 SONA hour or $5)**

For more information , contact vtaddictions@gmail.com

https://vt-psyc.sona-systems.com/exp_info.aspx?experiment_id=783 vtaddictions@gmail.com

https://vt-psyc.sona-systems.com/exp_info.aspx?experiment_id=783 vtaddictions@gmail.com
https://vt-psyc.sona-systems.com/exp_info.aspx?experiment_id=783 vtaddictions@gmail.com
https://vt-psyc.sona-systems.com/exp_info.aspx?experiment_id=783 vtaddictions@gmail.com
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https://vt-psyc.sona-systems.com/exp_info.aspx?experiment_id=783 vtaddictions@gmail.com

Appendix B

Phase I Consent Form

INFORMATION FORM FOR RESEARCH PROJECT

Project Title: Decision Making and Alcohol Use

Investigators

Principal Investigator: Robert Stephens, PhD, Professor

Co-Investigators: Kelsey Banes, M.S., Graduate Student

Psychology Department, Virginia Tech

Purpose and Procedure

The purpose of this study is to assess decision-making processes in relation to alcohol use in undergraduate college students. This is a two-phase study. This information sheet and consent form is for Phase I. You may, based on your responses during Phase I, be invited to participate in Phase II later in the semester. Phase II participation is completely voluntary. You may complete Phase I and later decide you don't want to be in Phase II. If you are invited to Phase II, you will be given additional information about what will be required before you are asked to decide whether you want to participate. Generally, Phase II will involve completing a series of imagining certain kinds of events and completing questionnaires in 302 Williams Hall, which will take about 75 minutes.

The remainder of this information sheet concerns only Phase I, the online survey. For this survey, you will be asked to complete a series of questions about your substance use and other experiences as well as questions designed to assess your decision-making style. Please read each question carefully and try to answer each question to the best of your ability. If you choose to participate in Phase I, you will be directed to a secure website to complete the survey.

Risks and Benefits

This survey takes only about 30 minutes to complete, but it is time that you could spend doing other activities. It is unlikely, but possible that you might find some of the questions distressing. If you are distressed during or after completing the survey, you can contact research staff by email (vtaddictions@gmail.com) to obtain a list of several services available to help you if you would like someone to talk to. Also, if the questions are too distressing for you, please remember that you can stop at any time.

There is no immediate and direct benefit to you for completing this survey. However, we hope that results of this project can help in designing future research and programs to benefit students. No promises or guarantees of benefits have been made to encourage you to participate.

Costs and Payment for Participation

There is no cost for participating in this survey, nor is any direct payment offered. If you are in a class that uses the Sona system, you will be offered 0.5 hours of Sona credit for participating in this online study. For information about how this extra credit will affect your grade and alternative ways to earn extra credit, please speak with your class instructor. Please refer to the Sona system to receive your extra credit: https://vt-psyc.sona-systems.com/. If you do not want or need Sona credit for participating, you will be entered into a raffle for one of two $50 gift cards (chances of winning are approximately one in 25). Even if you do not complete the whole survey, you will still be entered in the Sona system to receive the credit or entered into the raffle for a $50 gift card.

Confidentiality

Your name and e-mail address is collected at the bottom of this page and will be used solely for the purposes of assigning Sona credit, emailing gift certificates to winners of the raffle, and inviting individuals to Phase II. In order to receive credit on Sona or receive a gift card in the event you win the raffle, you MUST enter your name and e-mail address at the bottom of the page. Your name and e-mail address will be securely stored separately from your survey answers, and subject numbers will be assigned for data storage. As such, all of your answers will be kept strictly confidential. Sona administrators will be able to view who participated in the study for credit, but they will not have access to individuals' survey answers. Trained research assistants may also have access to a list of participant e-mail addresses not linked to participant data in order to assist with contacting participants for Phase II.

It is possible that the Institutional Review Board (IRB) may view this study's collected data for auditing purposes. The IRB is responsible for the oversight of the protection of human subjects involved in research. If you would like to contact the graduate student co-investigator conducting this study or the primary investigator, you are welcome to do so. Contact information is at the bottom of the following page.

You do not have to participate in this survey and, if you choose to participate, you can stop at any time. We do ask, however, that you try to answer every question completely to the best of your ability.

Subject's Responsibilities

As a participant in this study, you voluntarily agree to participate in this study. You have the following responsibilities:

Complete the questions to the best of your ability. Contact the researchers if you have any questions about the study.

Questions/Contact Information

If you have any questions about the protection of human research participants regarding this study, you may contact Dr. David Moore, Chair Virginia Tech Institutional Review Board for the Protection of Human Subjects, telephone: (540) 231-4991; email: moored@vt.edu or David W. Harrison, PhD, Chair Departmental Institutional Review Board, telephone: (540) 231-4422 ; email: dwh@vt.edu.

If you would like to speak with a member of this research team, please call Kelsey Banes or Dr. Robert Stephens at the Addictions Research Lab at (540) 231-7631 or email: vtaddictions@gmail.com.

Before continuing on to the survey, we ask that you please print a copy of this form for your records.

By entering your name and e-mail address below and continuing to the survey, you acknowledge that you have read this document and that you voluntarily consent to participate in this study.

We appreciate your input and thank you for your time and help in this study!

Phase II Consent Form

INFORMATION FORM FOR RESEARCH PROJECT

Project Title: *Decision Making and Alcohol Use*

Investigators

Principal Investigator: Robert Stephens, PhD, Professor

Co-Investigators: Kelsey Banes, M.S., Graduate Student

Psychology Department, Virginia Tech

Purpose of the Study

The purpose of Phase II of this research study is to develop a better understanding of how decision-making processes relate to alcohol use among college students. In order to decide whether or not you wish to be a part of this research study, you should know enough about its risks and benefits to make an informed decision. This consent form gives you detailed information about the research study, which a study investigator will also discuss with you if you choose to come to the research session.

Procedures

If you choose to participate in this research study, you will be asked to come to 302 Williams Hall for an in-person appointment lasting approximately 75 minutes. At the appointment, you will first meet with a study investigator to further discuss this consent form and address any questions you may have. Once you have all your questions answered, you will sign the consent form if you wish to continue with the session. After you consent, you will be randomly assigned to think about different events that happened recently or may happen in the future. You will also be asked to complete several online questionnaires. A week later, you will be sent a link to an online survey. This survey will contain similar questions to the ones you answered during the in-lab portion and will take about 45 minutes to complete. Following completion of the online follow-up, your participation in this study will be complete.

Risks and Benefits

One possible risk is experiencing anxiety or distress during some of the tasks. You might experience anxiety or discomfort in thinking about future or recent events. A second risk is related to confidentiality. We have procedures to ensure confidentiality and protection of your personal information (see below), but the risk of compromised confidentiality is still somewhat present.

There is no immediate, direct, or indirect benefit to you for participating in this study. No promises of benefits have been made to encourage you to participate. However, we hope that results of this project can help in designing future research to benefit students.

Costs and Payment for Participation

There is no cost for participating in this study. If you are in a class that uses the Sona system, you will be offered three hours of Sona credit for participating in this study (2 credits for the in-lab study and 1 credit for the online follow-up). For information about how this extra credit will affect your grade and alternative ways to earn extra credit, please speak with your class instructor. Please refer to the Sona system to receive your extra credit: https://vt-psyc.sona-systems.com/. If you do not want or need Sona credit, you will be offered $15 in gift cards ($10 for the in-lab and $5 for the follow-up). Even if you do not complete the whole session, you will still receive compensation for your time.

Confidentiality

Any identifiable information that is obtained in connection with this study will remain confidential and will be disclosed only with your permission or as required by U.S. or State law. Examples of information that we are legally required to disclose include suspected abuse of a child or elderly person, suicidality, and intention to harm identifiable others. Each person who participates in this study will be assigned a unique, identifying number. This number will be used to identify all research data within our database. The master list, which will contain your name and the unique identifying number, will be kept separate from all other data. Only the investigators of the study will have access to this master list.

When the results of the research are published or discussed in conferences, no information will be included that would reveal your identity. It is possible that the Institutional Review Board (IRB) may view this study's collected data for auditing purposes. The IRB is responsible for the oversight of the protection of human subjects involved in research. These individuals are required to keep all information confidential.

Freedom to Withdraw

You do not have to participate in this study. If you do participate, you can stop at any time and without penalty, by telling the researchers that you want to stop the study. If you decide to not participate or to withdraw from the study, your involvement in any future study will not be jeopardized.

Questions

Please feel free to ask about anything you do not understand. In addition, consider this research and the consent form carefully – as long as you feel is necessary – before you make a decision. If you would like to speak with a member of the research team, please call Kelsey Banes or Dr. Robert Stephens at the Addictions Research Lab at (540) 231-7631 or email: vtaddictions@gmail.com.

If you should have any questions about the protection of human research participants regarding this study, you may contact: Dr. David Harrison, Chair of Departmental Human Subjects Committee, telephone: (540) 231-4422, email: dwh@vt.edu, or Dr. David Moore, Chair Virginia Tech Institutional Review Board for the Protection of Human Subjects, telephone: (540) 231-4991; email: moored@vt.edu.

The following are some local resources available to you, should you need someone to talk with about mental health services or personal problems following your participating in this experiment. There is no guarantee that the listed services will be available to see you and it is your responsibility to pay any fees associated with such services. Cook Counseling Center provides services free of charge to Virginia Tech students who have paid their student health fees. The Raft Crisis Hotline is free to call. All other services may charge fees for their services.

ACCESS/Raft Crisis Hotline

(Emergency services clinicians)

(540) 961-8400

http://www.nrvcs.org/services.htm

Center for Family Services

(703) 538-8470

http://www.nvc.vt.edu/cfs

Cook Counseling Center

(540) 231-6557

http://www.ucc.vt.edu/

Mental Health Association of the New River Valley

(540) 951-4990; (800) 559-2800

http://www.mhanrv.org/

New River Valley Community Services

(540) 961-8400

http://www.nrvcs.org/

VT Psychological Services Center

(540) 231-6914

http://www.psyc.vt.edu/centers/psc/

Notification of Study Findings

☐ If you would like to receive a copy of the study findings after data collection has been completed, please place a checkmark in this box.

If you checked the above box, please print your email address so that we may contact you with the results. _____

Subject's Responsibility

As a participant in this study, you voluntarily agree to participate in this study. You have the following responsibilities:

1. Ask any questions you have about the study and the consent process.
2. Complete the research appointment.

Subject's Permission

I have read the Information Form and conditions of this project. I have had all my questions answered. I hereby acknowledge the above and give my voluntary consent.

_____

Subject signature Date

_____

Subject name (printed)

_____ _____

Study Investigator Name Investigator Signature Date

Appendix C

EFT Protocol

I. Task 1: Timeline follow-back Survey Questions (Part 1 Qualtrics Survey)
   a. *First, I'd like you to fill out this questionnaire about your alcohol use during the past week. Please enter the number of standard drinks you had on each day in the past week.*

II. Task 2: Episodic Thinking Procedure (Paper ET Form)
   a. *Next, I'd like you to think about some positive events that you're looking forward to in the future. The positive events should be ones that you anticipate being personally involved in. The positive events do not need to be ones that you're sure will actually happen, just events that you can imagine happening. I'm going to ask you to imagine events at specific times in the future. After that, we'll go back and rate the different events.*
   b. *What are some positive events that you can imagine in about…*
      i. One week: _____ (+3 days to +7 days)
      ii. One month: _____ (+21 days to +1 month)
      iii. 6 months:_____ (+4 months to +6months)
      iv. 1 year:_____ (+8 months to +1 year)
      v. 5 years:_____ (+3 years to +5 years)

III. Task 3: Episodic Thinking Ratings (Paper ET Form)
   a. Orient participant to scale: *Next, I'm going to ask you several questions about each event you just listed. For each question, I'd like for you to respond using this scale of 1 to 5 where 5 is very much.*
   b. Read questions: *When you imagine [event] [time period from today]* … read question prompts
   c. Make sure the participant is imagining self in event: *Please describe what you are imagining* (This is to make sure the participant is using first person and is self-projecting so you want "I imagine I am/we are …" or "I see, I feel, etc.")
      i. If the person isn't using these terms, prompt them to do so by saying, *Try to really imagine yourself in [the event]. What are you thinking/feeling/doing, etc?*
   d. Choose most vividly recalled event for each time period.
      i. Tie breakers: enjoyable, importance, exciting.
      ii. *In a minute, I'm going to prompt you to imagine some of the events you just rated. I'd like you to give me a cue word or short phrase that will prompt you to think of specific events. The cue shouldn't be in code. It should be very simple and straightforward—if the event was watching the superbowl, the cue could be superbowl or football game or football.*
      iii. *Give me a word or phrase to remind you to imagine [Event].*
      iv. Record one cue word/phrase for each time point.

IV. Task 4: Survey (Part 2 Qualtrics Survey)
   a. Tell the participant that he/she can take a short break while you set up the computer.
   b. Edit survey and enter each cue into the appropriate survey box
   c. Explain directions for imagining event: *When you come to a screen that looks like this, it is prompting you to imagine this event. Whenever you're prompted just take a minute to try to imagine the event. Imagine when and where it is, what you are doing and how you are feeling.*
   d. Remind participant to pay close attention to on-screen directions

EPT Protocol

I. Task 1: Timeline follow-back Survey Questions (Part 1 Qualtrics Survey)
   a. *First, I'd like you to fill out this questionnaire about your alcohol use during the past week. Please enter the number of standard drinks you had on each day in the past week.*

II. Task 2: Episodic Thinking Procedure (Paper ET Form)
   a. *Next, I'd like you to recall some positive events from your past. The positive events should be ones that you were personally involved in. I'm going to ask you to recall events at specific times in the past. After that, we'll go back and rate the different events.*
   b. *What are some positive events that you experienced about _____ ago ….*
      i. One week: _____ (-7 days to -3 days)
      ii. One month: _____ (-1 month to -21 days)
      iii. 6 months:_____ (-6 months to -4months)
      iv. 1 year:_____ (- 1 year to – 8 months)
      v. 5 years:_____ (-5 years to -3 years)

III. Task 3: Episodic Thinking Ratings (Paper ET Form)
   a. Orient participant to scale: *Next, I'm going to ask you several questions about each event you just listed. For each question, I'd like for you to respond using this scale of 1 to 5 where 5 is very much.*
   b. Read questions: *When you imagine [event] [time period from today]* … read question prompts
   c. Make sure the participant is imagining self in event: *Please describe what you are imagining* (This is to make sure the participant is using first person and is self-projecting so you want "I imagine I am/we are …" or "I see, I feel, etc.")
      i. If the person isn't using these terms, prompt them to do so by saying, *Try to really imagine yourself in [the event]. What are you thinking/feeling/doing, etc?*
   d. Choose most vividly recalled event for each time period.
      i. Tie breakers: enjoyable, importance, exciting.
      ii. *In a minute, I'm going to prompt you to imagine some of the events you just rated. I'd like you to give me a cue word or short phrase that will prompt you to think of specific events. The cue shouldn't be in code. It should be very simple and straightforward—if the event was watching the superbowl, the cue could be superbowl or football game or football.*
      iii. *Give me a word or phrase to remind you to imagine [Event].*
      iv. Record one cue word/phrase for each time point.

IV. Task 4: Survey (Part 2 Qualtrics Survey)
   a. Tell the participant that he/she can take a short break while you set up the computer.
   b. Edit survey and enter each cue into the appropriate survey box
   c. Explain directions for imagining event: *When you come to a screen that looks like this, it is prompting you to imagine this event. Whenever you're prompted just take a minute to try to imagine the event. Imagine when and where it is, what you are doing and how you are feeling.*
   d. Remind participant to pay close attention to on-screen directions

CET Protocol

I. Task 1: Timeline follow-back Survey Questions (Part 1 Qualtrics Survey)
   a. *First, I'd like you to fill out this questionnaire about your alcohol use during the past week. Please enter the number of standard drinks you had on each day in the past week. For [day of the week today], please enter the number of drinks you had last week on [day of the week], not today.*

II. Task 2: Episodic Thinking Procedure (CET Stimulus and Paper ET Form)
   a. *Next, I'm going to ask you to read some entries from a travel blog. After you've finished reading, I'll ask you to recall at least 5 different events from what you read. I'll then ask you a few questions about each event.*
   b. Once the participant has finished: *I'd like you to describe some of the events that happened in the blog you just read.*
   c. Make sure the participant has listed at least 5 events before proceeding. Filter out non-events as necessary.

III. Task 3: Episodic Thinking Ratings (Paper ET Form)
   a. Orient participant to scale: *Next, I'm going to ask you several questions about each event you just listed. For each question, I'd like for you to respond using this scale of 1 to 5 where 5 is very much.*
   b. Read questions: *When you imagine [event]* … read question prompts
   c. Choose the 5 most vividly recalled events.
      i. If there is a tie for vividness rating, use the following as tie breakers: enjoyable, importance, exciting. If there is still a tie, ask the participant which one he/she can imagine more clearly.
      ii. *In a minute, I'm going to prompt you to imagine some of the events you just rated. I'd like you to give me a cue word or short phrase that will prompt you to think of specific events. The cue shouldn't be in code. It should be very simple and straightforward—if the event was watching the superbowl, the cue could be superbowl or football game or football.*
      iii. *Give me a word or phrase to remind you to imagine [Event].*
      iv. Record the top 5 cue words/phrases.

IV. Task 4: Survey (Part 2 Qualtrics Survey)
   a. Tell the participant that he/she can take a short break while you set up the computer. Ask them to wait in the main lab if he/she doesn't get up on his/her own.
   b. Edit survey and enter each cue into the appropriate survey box
   c. Explain directions for imagining event: *When you come to a screen that looks like this, it is prompting you to imagine this event. Whenever you're prompted just take a minute to try to imagine the event. Imagine when and where it is, what you are doing and how you are feeling.*
   d. Remind participant to pay close attention to on-screen directions

Appendix D

Time: 1 week Event: _____
Chosen one? (Y / N)

Cue:	Not at All 1	2	3	4	Very Much 5
How enjoyable is this event?					
How important is this event?					
How exciting is this event?					
How well do you imagine/see the place, time, and the details of the event?					
Please describe what you are imagining. (Does participant use the 1st person? Yes or No)					
Does the event involve alcohol (Yes or no?)					

Time: 1 week Event: _____
Chosen one? (Y / N)

Cue:	Not at All 1	2	3	4	Very Much 5
How enjoyable is this event?					
How important is this event?					
How exciting is this event?					
How well do you imagine/see the place, time, and the details of the event?					
Please describe what you are imagining. (Does participant use the 1st person? Yes or No)					
Does the event involve alcohol (Yes or no?)					

Time: 1 week Event: _____
Chosen one? (Y / N)

Cue:	Not at All				Very Much

	1	2	3	4	5
How enjoyable is this event?					
How important is this event?					
How exciting is this event?					
How well do you imagine/see the place, time, and the details of the event?					
Please describe what you are imagining. (Does participant use the 1st person? Yes or No)					
Does the event involve alcohol (Yes or no?)					

Time: 1 month Event: _____
Chosen one? (Y / N)

Cue:	Not at All 1	2	3	4	Very Much 5
How enjoyable is this event?					
How important is this event?					
How exciting is this event?					
How well do you imagine/see the place, time, and the details of the event?					
Please describe what you are imagining. (Does participant use the 1st person? Yes or No)					
Does the event involve alcohol (Yes or no?)					

Time: 1 month Event: _____
Chosen one? (Y / N)

Cue:	Not at All 1	2	3	4	Very Much 5
How enjoyable is this event?					
How important is this event?					
How exciting is this event?					
How well do you imagine/see the place, time, and the details of the event?					
Please describe what you are imagining. (Does participant use the 1st person? Yes or No)					
Does the event involve alcohol (Yes or no?)					

Time: 1 month Event: _____
Chosen one? (Y / N)

Cue:	Not at All 1	2	3	4	Very Much 5
How enjoyable is this event?					
How important is this event?					
How exciting is this event?					
How well do you imagine/see the place, time, and the details of the event?					
Please describe what you are imagining. (Does participant use the 1st person? Yes or No)					
Does the event involve alcohol (Yes or no?)					

Time: 6 months Event: _____
Chosen one? (Y / N)

Cue:	Not at All	2	3	4	Very Much

	1				5
How enjoyable is this event?					
How important is this event?					
How exciting is this event?					
How well do you imagine/see the place, time, and the details of the event?					
Please describe what you are imagining. (Does participant use the 1st person? Yes or No)					
Does the event involve alcohol (Yes or no?)					

Time: 6 months Event: _____

Chosen one? (Y / N)

Cue:	Not at All 1	2	3	4	Very Much 5
How enjoyable is this event?					
How important is this event?					
How exciting is this event?					
How well do you imagine/see the place, time, and the details of the event?					
Please describe what you are imagining. (Does participant use the 1st person? Yes or No)					
Does the event involve alcohol (Yes or no?)					

Time: 6 months Event: _____
Chosen one? (Y / N)

Cue:	Not at All 1	2	3	4	Very Much 5
How enjoyable is this event?					
How important is this event?					
How exciting is this event?					
How well do you imagine/see the place, time, and the details of the event?					
Please describe what you are imagining. (Does participant use the 1st person? Yes or No)					
Does the event involve alcohol (Yes or no?)					

Time: 1 year Event: _____
Chosen one? (Y / N)

Cue:	Not at All 1	2	3	4	Very Much 5
How enjoyable is this event?					
How important is this event?					
How exciting is this event?					
How well do you imagine/see the place, time, and the details of the event?					
Please describe what you are imagining. (Does participant use the 1st person? Yes or No)					
Does the event involve alcohol (Yes or no?)					

Time: 1 year Event: _____
Chosen one? (Y / N)

Cue:	Not at All	2	3	4	Very Much

	1				5
How enjoyable is this event?					
How important is this event?					
How exciting is this event?					
How well do you imagine/see the place, time, and the details of the event?					
Please describe what you are imagining. (Does participant use the 1st person? Yes or No)					
Does the event involve alcohol (Yes or no?)					

Time: 1 year Event: _____

Chosen one? (Y / N)

Cue:	Not at All 1	2	3	4	Very Much 5
How enjoyable is this event?					
How important is this event?					
How exciting is this event?					
How well do you imagine/see the place, time, and the details of the event?					
Please describe what you are imagining. (Does participant use the 1st person? Yes or No)					
Does the event involve alcohol (Yes or no?)					

Time: 5 years Event: _____
Chosen one? (Y / N)

Cue:	Not at All 1	2	3	4	Very Much 5
How enjoyable is this event?					
How important is this event?					
How exciting is this event?					
How well do you imagine/see the place, time, and the details of the event?					
Please describe what you are imagining. (Does participant use the 1st person? Yes or No)					
Does the event involve alcohol (Yes or no?)					

Time: 5 years Event: _____
Chosen one? (Y / N)

Cue:	Not at All 1	2	3	4	Very Much 5
How enjoyable is this event?					
How important is this event?					
How exciting is this event?					
How well do you imagine/see the place, time, and the details of the event?					
Please describe what you are imagining. (Does participant use the 1st person? Yes or No)					
Does the event involve alcohol (Yes or no?)					

Time: 5 years Event: _____
Chosen one? (Y / N)

Cue:	Not at All	2	3	4	Very Much

	1				5
How enjoyable is this event?					
How important is this event?					
How exciting is this event?					
How well do you imagine/see the place, time, and the details of the event?					
Please describe what you are imagining. (Does participant use the 1st person? Yes or No)					
Does the event involve alcohol (Yes or no?)					

Notes:_____
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Appendix E

DDQ (Average Week)

We would like to ask you about you some more questions about your use of alcohol and other drugs.

These questions will be asking about the past 30 days.

Please refer to the image below for questions that ask about the number of standard drinks you have consumed.

IN THE CALENDAR BELOW, PLEASE FILL-IN YOUR DRINKING DURING A TYPICAL WEEK IN THE LAST 30 DAYS.

First, think of a typical week in the last 30 days. (Where did you live? What were your regular weekly activities? Where you working or going to school? Etc.) Try to remember as accurately as you can, how much you typically drank in a week during that one month period?

For each day of the week in the calendar below, fill in the number of standard drinks typically consumed on that day.

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Number of Drinks	☐	☐	☐	☐	☐	☐	☐

DDQ (Past week)

We would like to ask you about you some questions about your alcohol consumption during the past week.

Please refer to the image below for questions that ask about the number of standard drinks you have consumed.

IN THE CALENDAR BELOW, PLEASE FILL-IN YOUR PAST-WEEK DRINKING.

First, think of the week your past week. (Where were you? What are your regular weekly activities? Where are you working or going to school? Etc.) Try to recall your drinking in the past 7 days.

For each day of the week in the calendar below, fill in the number of standard drinks you consumed on that day in the box below.

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Number of Drinks	☐	☐	☐	☐	☐	☐	☐

Alcohol Use Intentions

We would like to ask you about you some questions about your intentions to use alcohol over the next week.

Please refer to the image below for questions that ask about the number of standard drinks you plan to consume.

IN THE CALENDAR BELOW, PLEASE FILL-IN YOUR ANTICIPATED DRINKING DURING THE UPCOMING WEEK.

First, think of the week you have coming up. (Where will you be? What are your regular weekly activities? Where are you working or going to school? Etc.) Try to guess how much will be drinking each day in the next 7 days.

For each day of the week in the calendar below, fill in the number of standard drinks you anticipate consuming on that day in the box below.

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
Number of Drinks	☐	☐	☐	☐	☐	☐	☐

Appendix F

Example of Cued Delay Discounting

Appendix G

Example of Episodic Thinking Prompt Screen