MASTER'S THESIS

DECREASING PROBLEMATIC ALCOHOL USE WITH BEHAVIORAL STRATEGIES: A COGNITIVE MODEL

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ABSTRACT

DECREASING PROBLEMATIC ALCOHOL USE WITH BEHAVIORAL STRATEGIES: A COGNITIVE MODEL

Problematic alcohol use is a pattern of hazardous consumption that commonly leads to negative outcomes that affect college students' ability to complete day-to-day responsibilities. Behavioral strategies such as ensuring a safe ride home or avoiding drinking games is linked to a reduction of alcohol-related consequences by providing concrete tactics to enable a change in patterns of consumption . Thus, improving an individual's ability to utilize these strategies before or during alcohol consumption is targeted in contemporary interventions and preventative approaches. In spite of this practice, much is unknown regarding the underlying cognitive facilities needed to: retain awareness of these strategies, choose approaches in accordance with the situation at hand and update these tactics as needed. If the ability to productively utilize these methods is dependent on cognitive abilities, then individuals with poor cognitive function may be at a disadvantage. The aim of the current study was to investigate the roles of executive cognitive functioning and metacognition as they relate to behavioral strategy usage and adverse alcohol-related outcomes. Results indicate that executive cognitive functioning is inversely related to the number of experienced alcohol-related consequences. Furthermore, low executive function and metacognitive beliefs about alcohol pertaining to the cognitive harm of drinking interacted to significantly affect the use of behavioral strategies, which in turn was inversely related to consequences. The findings of the current study offered a cognitive-based model in support of the practice of employing strategies to decrease alcohol-related consequences, and

determined whether implementation of these tactics can successfully take place in those with poor cognitive and metacognitive function.

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INTRODUCTION

Alcohol consumption amongst college students is a public health crisis (White & Hingson, 2013). The National Survey on Drug Use and Health indicates that 37.9% of students engage in binge drinking (i.e., four to five drinks in one sitting) and that roughly 20 percent of students meet criteria for past-year alcohol abuse or dependence (National Institute on Alcohol Abuse and Alcoholism, 2015). Moreover, alcohol use increases when students enter university settings, and these rates of drinking are 10 percent higher than their non-student peers (National Institute on Alcohol Abuse and Alcoholism, 2015). The college drinking culture often encourages steep increases in blood-alcohol concentrations in a short amount of time (Hingson, Zha, Simons-Morton, & White, 2016). This pattern of alcohol use, which includes chugging alcohol during drinking games, drinking on an empty stomach, and drinking with the goal of high intoxication, as examples, is problematic as it incites a higher risk of negative alcohol-related consequences. (Giles, Champion, Sutfin, McCoy, & Wagoner, 2009; Ray, Stapleton, Turrisi, & Mun, 2014).

Problematic alcohol use refers to a pattern of hazardous consumption that negatively impacts an individual's health or their ability to carry out day-to-day activities (Whiteside, Cronce, Pedersen, & Larimer, 2010). This pattern of drinking is linked to immediate consequences such as physical violence, sexual assault, reckless behavior, academic problems and serious injury (see Perkins, 2002 for a review). Such consequences are particularly widespread in student populations. Each year in the United States, college alcohol use accounts for 1,825 deaths, 400,000 unsafe sexual encounters, 696,000 assaults, and 4.86 million drunk

driving incidents (National Institute on Alcohol Abuse and Alcoholism, 2017). The various terms mentioned in this analysis that pertain to these factors are defined in Table 1.

Behavioral Interventions to Decrease Alcohol Use

The high prevalence of alcohol-related consequences in the college population launched countless initiatives to decrease negative outcomes. These behavioral interventions were developed by identifying various motivational factors that encourage problematic drinking, such as expectations of how alcohol will affect internal states, learned associations between drinking behaviors and situational outcomes, and skewed perceptions of what kind of drinking patterns are the norm. The first type of motivational factor stemmed from students' expectations of how alcohol affects their internal state or external situation (Mallett et al., 2013). An individual who believes that drinking is a positive experience expects that alcohol has a constructive effect on mental states or environmental contexts. Such expectancies include beliefs that alcohol will enhance mood, promote assimilation or complicity within a social group, or offer a coping mechanism for anxiety or depression (Lyvers, Hasking, Hani, Rhodes, & Trew, 2010). On the contrary, individuals who associate drinking with negative experiences may also anticipate that drinking alcohol is related to violence, the inability to stop drinking, or other negative outcomes (MacKillop, Lisman, & Weinstein, 2006). The expectations and beliefs that people associate with alcohol use act as strong motivational factors that either encourage the continuation or the alteration of problematic drinking patterns in the face of negative experiences. This relationship between motivation and behavior is often predictive of subsequent drinking and/or related consequences (Merrill & Read, 2010; Park & Levenson, 2002).

Early behavioral interventionists used various tactics to try to change these expectations, knowing that they play a substantial role in motivating the continuation of problematic drinking

patterns. Techniques focused on informing students about the health risks of problematic drinking patterns in an attempt to change students' expectations that drinking alcohol would be a positive experience. However, these techniques often used messages that threatened the students' view of themselves as sensible and rational decision makers, and merely made students more defensive about their decisions (Leffingwell, Neumann, Leedy, & Babizke, 2007; Steele, 1988). The results from these studies suggested that tactics to reduce problematic drinking should be renovated. Adjustments were then put into place to guide self-reflection on personal values and attitudes towards drinking to increase open-mindedness about health message acceptance (Harris & Epton, 2009). While this new technique successfully decreased students' defensive processing of risks, there was only modestly significant observed changes in actual alcohol consumption, when it was observed at all (Larimer & Cronce, 2007; Norman & Wrona-Clarke, 2016; Scott, Brown, Phair, Westland, & Schuz, 2013).

The ultimate failure of these interventions to decrease problematic drinking highlights the notion that targeting motivational factors associated with expectations may not be enough to effectuate behavioral change (Norman et al., 2018). Students may be motivated to change problematic drinking patterns due to more realistic expectations of drinking outcomes, but these interventions fail to actively supply the tools necessary to implement such goals (see Gollwitzer & Sheeran, 2006 for a meta-analytic review).

The second cluster of motivational factors related to problematic drinking and alcohol-related consequences is comprised of learned associations between established behavioral patterns and outcomes. Learning theories applied to alcohol use posit that drinking patterns are more likely to be reinforced if outcomes following the behavior are perceived as positive, thus offering motivation to continue the same pattern in the future. Motivation to change drinking

patterns can increase by repeatedly experiencing negative outcomes following drinking, as the individual learns that drinking behavior and these consequences are consistently linked (see Labbe & Maisto, 2011 for a review).

Interventions considered the importance of learned associations between drinking patterns and outcomes when deciphering the motivational features of problematic alcohol use. These approaches aimed to increase self-awareness of the connection between drinking and negative-related outcomes by providing feedback on students' own consumption patterns, incidences of risky situations they engage in during drinking, and negative outcomes that typically follow. Increased awareness of past alcohol-related consequences helps to weaken previously-reinforced drinking patterns and shifts motivation toward establishing new, healthier habits (see Carey, Scott-Sheldon, Garey, Elliott, & Carey, 2016 and Scott-Sheldon, Carey, Elliott, Garey, & Carey, 2014 for meta-analytic reviews). These techniques were marginally more successful interventions for problematic drinking compared to the aforementioned earlier interventions; the former promoted an increased awareness of drinking patterns for students who did not realize they commonly experienced negative alcohol-related outcomes (Prochaska, DiClemente, & Norcross, 1992). The literature suggests that while self-awareness interventions should have a strong effect on patterns of alcohol use on a theoretical basis, they are not always successful in practice as insight does not necessarily translate to behavioral change (Norcross, Krebs, & Prochaska, 2010). The lack of robust change in drinking behaviors led to the development of a third type of motivation-based intervention rooted in students' misperceptions of peers' drinking habits.

The idea that students possess misperceptions about their peers' drinking patterns was formulated in consideration of Deviance Regulation Theory (Blanton, Stuart, & Van den

Eijnden, 2001). The theory offers a predictive model in which the incentive to engage in a particular behavior results from both the perceived normative frequency of the behavior within a reference group and the perception of people who do or do not engage in the behavior (Dvorak et al., 2018). There is often a discrepancy between what an individual believes is the norm and what is actually the norm (i.e., pluralistic ignorance; Prentice & Miller, 1993). Students commonly believe that their rates of alcohol use are similar to their peers, but their perceptions are often drastically higher than the actual rate of alcohol use amongst peers (Lewis, Neighbors, Oster-Aaland, Kirkeby, & Larimer, 2007).

Several norm-based interventions have focused on this discrepancy. Researchers believed that by emphasizing to students that their individual drinking rates are higher than most other people in a similar group, the students' would be motivated to change their own patterns of use (Lewis & Neighbors, 2006). These tactics effectively lessened the gap between an individual's perceived and actual normative drinking rate, but the effect of this correction on changes in alcohol consumption and related consequences is unclear (see Huh et al., 2015 for a meta-analysis; Neighbors, Larimer, & Lewis, 2004). Some studies suggest that reducing pluralistic ignorance decreases alcohol use and related consequences (Bewick, Trusler, Mulhern, Barkham, & Hill, 2008; Lewis & Neighbors, 2007). Dvorak and colleagues (2018), however, contend that while these studies focus on interventions to reduce alcohol use, they do not necessarily result in fewer alcohol-related consequences.

To review, motivation to engage in drinking patterns that inadvertently encourage alcohol-related consequences arises in several different ways. Some individuals are motivated to drink with the expectation that alcohol positively affects their internal states or environmental outcomes, and alternatively, others may have preconceived associations between drinking and a

perceived lack of negative outcomes. Initial interventional techniques promoted a motivational shift towards goal-setting (e.g., "I will not drink to the point of becoming aggressive towards others") in light of reducing consequences, but the interventions lacked concrete direction on how to achieve these goals (see Gollwitzer & Sheeran, 2006 for meta-analytic review).

Ensuing research attempted to tackle these shortcomings by shifting from a purely motivational focus to trying to incorporate students' knowledge of concrete ways in which harm-reduction goals can be attained (Gollwitzer, 1999). If the goal was to decrease the consequences of harmful drinking, such strategies may include leaving a bar or party early, avoiding drinking games or going home with a friend. These tactics apply specific methods to achieve goals, rather than simply setting the goal (e.g., intention to drink less), and are established behavioral strategies known to facilitate change (Murgraff, Abraham, & McDermott, 2007; Murgraff, White, & Phillips, 1996; Norman & Wrona-Clarke, 2016).

Multiple studies have demonstrated that the use of these behavioral strategies links drinking motives with alcohol use and related consequences (see Pearson, 2014 for a review). Specifically, behavioral strategies mediate the relation between the motivation to drink and alcohol-related outcomes (Bravo, Prince, & Pearson, 2017; Cooper, Russell, Skinner, & Windle, 1992; LaBrie, Lac, Kenney, & Mirza, 2001; Martens, Ferrier, & Cimini, 2007; Martens et al., 2007). As previously discussed, the motivation to continue or change current drinking behavior may arise from learned beliefs from previous situations that either reinforced or punished past drinking patterns, respectively. Thus, students with positive expectations of drinking (i.e., mood enhancement, commemoration of a social occasion, coping mechanism) are more motivated to continue current patterns of consumption as they are less likely to expect negative related outcomes. Since they do not expect negative outcomes, these individuals are less likely to

employ behavioral strategies aimed to decrease use and related consequences. Although implementing behavioral strategies is an effective method to decrease consequences, students are less inclined to sense the need to do so if they anticipate positive outcomes from drinking. Therefore, both beliefs about alcohol and behavioral strategy usage appear to be significantly related to the perpetuation of negative drinking-related outcomes.

Several studies have demonstrated the inverse relationship between behavioral strategy use and alcohol-related consequences; however, applied interventions that specifically promote behavioral strategy use to decrease consequences are often inefficacious (LaBrie, Napper, Grimaldi, Kenny, & Lac, 2015; Sugarman & Carey, 2009). This shortcoming may have resulted from a lack of consideration of Deviance Regulation Theory, the basis of the third previously mentioned source of drinking motivation. This theory states that the incentive to engage in a particular behavior results from both the perceived normative frequency of the behavior within a reference group and the perception of people who do or do not engage in the behavior. Applying the theory to interventions did not appear to influence problematic alcohol use or related consequences within the framework of pluralistic ignorance, but Dvorak and colleagues (2018) elected to consider other aspects of the theory. Deviance Regulation Theory additionally proposes that counter-normative behavior is more salient to individuals than normative behavior, and is a greater motivational factor when choosing to engage in a pattern of behavior (Blanton, Stuart, & Van den Eijnden, 2001). The study authors hypothesized that in students who believe that behavioral strategy use is uncommon amongst their peers, a positive message about those who frequently utilize these strategies will motivate students to use them more often. Individuals prefer to deviate from the norm in a positive way; thus, they will be more motivated to use strategies to positively stand out from their peers. The results of the study indicate that although

this intervention increased the use of behavioral strategies over time, similar to its predecessors, there were minimal effects on changes in alcohol use or related consequences.

Countless behavioral interventions have been developed with the intention to decrease alcohol use and/or related consequences in college students, yet many have been unsuccessful in doing so. Educating students on the health risks of drinking in conjunction with promoting acceptance and open mindedness of health messages merely improved motivation to change problematic drinking patterns, but did not provide the means to achieve those goals. Other interventions either increased students' self-awareness of the connection between problematic drinking and consequences or reduced the discrepancy between perceived and actual drinking norms. These tactics similarly shed light on the need to change behavior, but again did not provide students with the tools to implement change. Consequent interventions targeted the use of behavioral strategies to decrease alcohol-related consequences. While these approaches had the ability to increase the amount of behavioral strategies used in the context of problematic drinking, the link between behavioral strategy interventions and a reduction of negative outcomes was less than robust.

The relative failure of these interventional methods to consistently reduce alcohol-related consequences may be due to their shared foundation in similar underlying motivational factors. The motivation to drink coming from the expected effects of alcohol led to interventions that emphasized health risk messages and acceptance of those messages. The motivation to continue the same pattern of drinking or to change based on reinforced behaviors inspired interventions that aimed to increase self-awareness of problematic drinking and related consequences. The motivation to drink in reference to perceived normative frequencies inspired norms-based interventions. Insight from all three origins of motivation influenced the continued improvement

of behavioral strategy interventions. The behavioral strategy approach currently emerges as the most widely accepted target to decrease problematic alcohol use, as strategy use has been clearly and consistently demonstrated to mediate the relation between motives and consequences. Nonetheless, the lack of a stable, significant relationship between these interventions and a change in alcohol-related outcomes in applied settings highlights the need to explore stronger factors, both motivational and otherwise, that may either encourage problematic alcohol use, or inhibit an individual's ability to effectively implement behavioral strategies to decrease use.

Moving away from traditional approaches towards the identification of alternative factors that relate to problematic drinking will promote the development or advancement of behavioral strategy interventions that can more reliably reduce alcohol-related consequences in applied settings. The current study aimed to identify factors that have not been customarily sought out when improving behavioral strategy interventions but may relate to an individual's ability or desire to effectively utilize strategies. If such a connection is found, then the results of this study will aid in the understanding of why previous applied strategy interventions may have failed, and will offer empirically-supported directions in which to target forthcoming efforts to decrease the experience of alcohol-related consequences in college students. The following sections introduce metacognitive beliefs about alcohol and executive cognitive function as two constituents that were expected to significantly affect an individual's motivation or ability to effectively implement behavioral strategies to reduce alcohol-related consequences.

Metacognitive Beliefs about Alcohol

As formerly reviewed, the expectancies and beliefs that people associate with alcohol use are strong motivational factors related to problematic drinking patterns. These beliefs play a powerful role, despite experiencing negative consequences, and are related to subsequent

drinking and/or related outcomes (Merrill & Read, 2010; Park & Levenson, 2002). Research suggests that metacognitive beliefs, or the self-awareness of how alcohol will specifically influence your ability to self-regulate, may be a more robust predictor of problematic alcohol use (Spada, Moneta, & Wells, 2007).

Metacognitive beliefs refer to the knowledge of how you are functioning and the available coping strategies at your disposal to change these internal states as needed (Wells, 2000). People form conclusions about the significance of certain thoughts, (e.g., "I can't finish anything and that means I'm worthless"), emotions (e.g., "I need to control my anxiety at all times"), and cognitive competence (e.g., "I do not trust my problem solving capabilities"). How an individual chooses to change these states depends on an accurate representation of the current environment, one's abilities, and knowing which behavioral options would best fit with the situational context (Wells, 2000). Metacognitive knowledge of potential behavioral options to change internal states can either be positive (e.g., "Ruminating will help me find a solution") or negative (e.g., "My checking behavior is making me lose my mind"; Spada & Wells, 2008; Wells, 2000). Dysfunctional metacognitive beliefs are theorized to heavily factor in the maintenance of maladaptive behavioral patterns, as these beliefs are activated in the face of problematic situations and drive coping tactics, such as alcohol use (Spada & Wells, 2008; Wells & Matthews, 1994, 1996; Wells, 2000).

Metacognitive beliefs about the expected effects of alcohol and the knowledge of available behavioral options may be either positive or negative. Positive metacognitive beliefs about alcohol include the perceived effect of drinking on problem solving ability (e.g., "Drinking makes me think more clearly"), thought control (e.g., "Drinking helps me to control my thoughts"), attention regulation (e.g., "Drinking helps me focus my mind"), and self-image

regulation (e.g., “Drinking reduces my self-consciousness”). Negative metacognitive beliefs refer to the perceived lack of executive control over alcohol consumption (e.g., “My drinking persists no matter how I try to control it”) and the perceived cognitive cost of drinking (e.g., “Drinking will damage my mind”; Spada & Wells, 2006, 2008). Increased consumption of alcohol from non-problematic, to problematic, to alcohol use disorder-levels is positively related to the extent of one’s metacognitive beliefs about alcohol, and these beliefs likely play a significant role in the initiation and perpetuation of drinking behavior (Spada, Moneta, & Wells, 2007).

Metacognitive beliefs about alcohol are worth considering above non-metacognitive beliefs and expectancies when deciphering an individual’s motivation to engage in problematic drinking patterns. Compared to the endorsement of negative emotions, both positive and negative metacognitive beliefs are more significantly associated with problematic drinking. (Spada & Wells, 2005; Spada, Zanvoort, & Wells, 2007). Spada, Moneta, and Wells (2007) report that metacognitive beliefs about alcohol explain individual variance in drinking patterns over and above non-metacognitive beliefs, such as fun, sex, tension reduction, social performance, and physical performance. Specifically, positive metacognitive beliefs of cognitive self-regulation and emotional self-regulation, and negative metacognitive beliefs about uncontrollability, independently predict drinking behavior. When controlling for these three categories in analyses, the only non-metacognitive belief that explains additional variance above metacognitive beliefs is negative social performance. These findings indicate that a person’s anticipated effect of drinking on his or her cognitive ability to self-regulate is a strong motivator to continue or change current drinking patterns. While promising, the importance of metacognitive beliefs about alcohol have yet to be examined in the context of behavioral strategy usage and alcohol-

related consequences. Metacognitive beliefs encompass the knowledge of how you are cognitively and emotionally functioning and the available coping strategies at your disposal to change these internal states as needed (Wells, 2000). Adaptive metacognitive beliefs about alcohol may be critical in the ability to accurately call to mind certain behavioral strategies that would be most advantageous in a given situation and to promote appropriate uses of such strategies when faced with the desire or need to decrease alcohol-related consequences.

These characteristics informed the hypotheses of the current study in conjunction with the findings that metacognitive beliefs superiorly predict alcohol-related outcomes over non-metacognitive beliefs. It was expected that adaptive metacognitive beliefs about alcohol would facilitate the successful implementation of behavioral strategies, which would further relate to decreased experiences of alcohol-related consequences. Specifically, negative metacognitive beliefs about alcohol (i.e., beliefs that alcohol will cause cognitive harm and/or that the amount drank will be uncontrollable) would increase students' motivation to use behavioral strategies, which would in turn relate to decreased experiences of consequences. Conversely, positive metacognitive beliefs about alcohol (i.e., beliefs that alcohol will foster cognitive and/or emotional self-regulation) would be less motivating in the decision to engage in strategy use, such that more positive metacognitive beliefs would relate to less behavioral strategy use and more experiences of alcohol-related consequences. By exploring the importance of metacognitive beliefs about alcohol in the context of suitably utilizing behavioral strategies, an entirely new area of motivational factors can be investigated in the pursuit of an effective applied behavioral intervention to decrease problematic alcohol use.

Executive Cognitive Function

While metacognitive beliefs about alcohol further elucidate students' motivation to engage in such behavioral patterns, students' executive cognitive function (ECF) abilities may reveal that some students are unable to engage in adaptive drinking behaviors due to impairments in decision making processes. Executive cognitive function refers to a set of skills essential for the ability to formulate, initiate and regulate goal-directed behaviors by utilizing external and internal feedback to adaptively modulate future decisions (Giancola, Martin, Tartar, Pelham & Moss, 1996; Foster, Eskes & Stuss, 1994). Executive cognitive function is implicated in the proficiency to make appropriate decisions by means of choosing and implementing optimal behavioral strategies according to situational context. The processes involved in these judgments include set-shifting, information updating, monitoring and inhibition of pre-potent responses (Fisk & Sharp, 2004; Miyake et al., 2000).

The formulation and regulation of goal-directed behavior in the context of alcohol-related consequences has been examined via self-regulation measures (Littlefield, Sher & Wood, 2009; Magid, MacLean, & Colder, 2007; Quinn & Harden, 2013). Self-regulation refers to the engagement of goal-related behaviors associated with the promotion of long-term health values. These abilities are suggested to be distal antecedents to the previously discussed behavioral strategies mediation model, such that high self-regulatory abilities relate to the motivation to prioritize long-term health goals, which in turn increases the incidence of behavioral strategies and decreases the experience of negative alcohol outcomes (see Bravo, Prince, & Pearson, 2015 for a replication analysis) The construct of self-regulation has been assessed in college students via personality measures and other self-report measures that capture the occurrence of goal-related behaviors, including checking progress towards a goal and searching for solutions to problems. Bravo, Prince, and Pearson (2015) reported that when each factor was regarded in

separate models, age of first use, self-regulation, impulsivity, depressive symptoms and conscientiousness were all indirectly associated with alcohol use and related consequences through behavioral strategies. When assembled in a single comprehensive model, however, only behavioral strategies significantly mediated the relation between age of first use/self-regulation and alcohol use/consequences. This finding suggests that a strong connection exists between self-regulatory aspects of ECF, behavioral strategy use and alcohol-related consequences in college students.

An additional aspect of ECF that has been linked to alcohol use and related outcomes in students is working memory (Ambrose, Bowden, & Whelan, 2001; Lovallo, Yechiam, Sorocco, Vincent, & Collins, 2006). Working memory is a facet of ECF that is essential for accurate decision making. The construct encompasses the multifaceted ability to perceive aspects about a situation, incorporate knowledge from prior experiences, and determine how to respond appropriately (see Baddeley, 2003 for a review). Deficits in self-regulation (Littlefield, Sher & Wood, 2009; Magid, MacLean, & Colder, 2007; Quinn & Harrden, 2013) and working memory (Ambrose, Bowden, & Whelan, 2001; Lovallo, Yechiam, Sorocco, Vincent, & Collins, 2006) have been separately associated with problematic drinking patterns, but the two constructs emerge as joint influences on alcohol-related outcomes, as well. Specifically, working memory ability has linked disinhibition (i.e., a lack of self-regulation related to acting without thinking or planning) to alcohol use in general and consuming alcohol specifically for intoxicating effects (Ellingson, Fleming, Verges, Bartholow, & Sher, 2014). These associations have been posited to relate to inaccuracies in metacognitive knowledge pertaining to the risk of experiencing negative consequences (Bechara, Damasio, Tranel, & Anderson, 1998). Working memory deficits may inhibit the ability to both accurately recall past alcohol-related consequences and to relate those

outcomes to future events (Bickel, Yi, Landes, Hill, & Baxter, 2011). This inability to effectively maintain knowledge about past consequences hinders self-regulatory functions. If a student fails to consider past negative outcomes of drinking, then they would be less likely to exhibit behavior that aims to prevent or avoid future negative outcomes, thus neglecting a long-term health goal. Decreasing the value of long-term health goals in favor of immediate temptations (i.e., poor self-regulatory abilities) may foster the perpetuation of negative consequences by overlooking the need to use behavioral strategies. The above research demonstrates that multiple ECF components interact to produce the ability to accurately, appropriately and effectively make decisions in specific situational contexts.

Ineffective ECF may impede students' ability to maintain self-regulation in favor of long-term health goals, which in turn expands the risk of experiencing alcohol-related negative consequences. Moreover, as working memory relates to choosing appropriate coping tactics based on prior knowledge and situational context (i.e., metacognitive beliefs), inaptitude may also hinder the capability of students to employ appropriate behavioral strategies. In these ways, ECF deficits encourage high levels of alcohol-related consequences by decreasing the impact of past negative outcomes, thus failing to alert the person of the need to implement strategies, and by constraining the ability to implement appropriate behavioral strategies in the event that avoidance of negative outcomes is needed.

Previous studies have suggested that various aspects of ECF in college students relate to problematic drinking patterns and increased alcohol-related consequences, such that those with poor ECF abilities may be unable to successfully implement behavioral strategies. Metacognitive beliefs about alcohol may provide evidence of a previously unidentified motivational factor affecting effective behavioral strategy use. Furthermore, examining ECF may reveal that an

inability to implement strategies is similarly important. Thus, in addition to the stated aims regarding the investigation of metacognitive beliefs about alcohol in relation to behavioral strategy use and related consequences, the current study aimed to determine the association between ECF and consequences by employing a more comprehensive measure of ECF than ever before used. By assessing ECF more completely, a greater case may be had that this construct importantly connects to behavioral strategy use and negative alcohol-related outcomes. In addition to the previously stated hypotheses pertaining to metacognitive beliefs about alcohol, it was hypothesized that ECF would inversely relate to alcohol-related consequences. If findings suggest that this association holds true, interventional techniques can target the improvement of ECF in the pursuit of decreasing these negative outcomes.

Current Study and Hypotheses

The current study examined the impact of ECF and metacognitive beliefs in the context of behavioral strategy use and alcohol-related negative consequences. A number of co-variates were included to examine whether ECF, metacognitive beliefs about alcohol, and behavioral strategies predicted alcohol-related consequences above and beyond other related elements. The included co-variates of history of brain injury, depression, anxiety, biological sex, and drinks per drinking day have been shown in previous studies to relate to the main variables of interest. As such, the following hypotheses were put forth:

1) A negative relationship between ECF and alcohol-related consequences would be observed.

2) Behavioral strategies would mediate the relation between ECF and alcohol-related consequences, such that higher ECF corresponds to more behavioral strategy use, which in turn leads to lower alcohol-related consequences.

3) Metacognitive beliefs about alcohol would moderate the relation between ECF and behavioral strategy use, such that adaptive metacognitive beliefs about alcoholfacilitate the successful implementation of behavioral strategies.

3a) Negative metacognitive beliefs about the cognitive harm of alcohol would increase students' motivation to use behavioral strategies, which would in turn relate to decreased experiences of consequences.

3b) Negative metacognitive beliefs that the amount one drinks is uncontrollable would not have a significant association with behavioral strategy use. This factor has been linked to the perpetuation of alcohol use rather than initiation and has been implicated in individuals with alcohol-use disorders (Spada & Wells, 2010). The current sample was expected to exhibit sub-clinical alcohol consumption patterns and thus not likely to express this factor.

3c) Positive metacognitive beliefs about alcohol (i.e., beliefs that alcohol fosters cognitive and/or emotional self-regulation) would be less motivating in the decision to engage in strategy use, such that more positive metacognitive beliefs would relate to less behavioral strategy use and more experiences of alcohol-related consequences.

4) The covariates of traumatic brain injury history, depression, anxiety, biological sex, and alcohol consumption (i.e., drinks per drinking day) would relate to the main variables of interest in ways described below. However, ECF, metacognitive beliefs, and behavioral strategies would be significantly associated with alcohol-related consequences over and above these other elements.

4a) History of traumatic brain injury would be inversely related to ECF. TBI severity is commonly assessed on a continuous spectrum projected from a number of factors. Severe TBI

may denote a low level of consciousness and/or lasting unconsciousness, or may indicate highly impaired cognitive and behavioral functioning post-injury (Teasdale & Jennet, 1974). The diagnosis and management of severe TBI is more familiar to physicians; however, 70-80% of all TBIs are mild in that the deficits are often less functionally debilitating and may not appear on imaging scans (Jennett, 1996; Dikmen, Machamer, & Temkin, 2001). Although multiple definitions of what constitutes a mild TBI (i.e., a concussion) exist throughout the literature, the most widely-accepted criteria were proposed by the American Congress of Rehabilitation Medicine (ACRM; 1993). According to ACRM, evidence of any one of the following symptoms subsequent to mechanical trauma to the brain merits a diagnosis of mild TBI (i.e., concussion): a loss of consciousness for 30 minutes or less, post-traumatic amnesia lasting less than 24 hours, an alteration of mental state at the time of the injury (e.g., confusion, disorientation), or focal neurologic deficit(s).

College students are at higher risk of enduring traumatic brain injuries of varying degrees of severity than the general population, both because they are more likely to participate in contact sports and because their drinking often promotes unsafe behavior (Lorant, Nicaise, Soto, & d'Hoore, 2013; Zuckerman et al. 2015). The current study used history of TBI as a co-variate in the ensuing data analyses due to the increased risk among college students and the deleterious effects of TBI on ECF.

4b) Depression and anxiety would negatively relate to ECF. Previous research indicates that depressive symptoms and/or symptoms of anxiety, including those at sub-clinical levels, are related to cognitive function in young adults in this manner (Dotson et al. 2014).

4c) The endorsement of positive versus negative metacognitive beliefs about alcohol would be dependent on biological sex. Previous research has indicated that females are more likely to exhibit positive metacognitive beliefs about alcohol, and that males are more likely to endorse negative beliefs (Spada, Zandvoort, & Wells, 2007). The current study expected similar relations to occur.

4d) Alcohol consumption (i.e., drinks per drinking day) would be positively associated with alcohol-related consequences. Alcohol consumption was included as a co-variate, and not as a primary variable of interest, as consumption is only moderately associated with consequences (Mallet, Marzell, & Turrisi, 2011).

METHODS

Participants

Participants included 223 undergraduate students recruited from PSY100 (Introduction to Psychology) and PSY250 (Research Methods) courses at Colorado State University in the fall of 2018 and spring of 2019. Recruitment and subsequent study procedures were approved by the University's Institutional Review Board. Inclusion criteria required having normal or corrected vision and hearing, as well as fluency in English. Exclusion criteria included no reported lifetime use of alcohol as measured by a yes or no question. This criterion was set as students with no lifetime use of alcohol would not have experienced consequences from drinking. Without excluding these students, the average number of alcohol-related consequences across all participants would have been lower and may not have accurately represented the relationship between ECF and experienced consequences. Thirteen students reported no lifetime use of alcohol, resulting in a final *N* of 210. Participants completed a screening questionnaire in these courses prior to inclusion in the study. The screening process included questions pertaining to the participants' history of TBI among other demographic and psychological measures.

All participants were compensated with partial course credit. Data was entered electronically and was double password protected, such that one password was required to log on to the computer and a different one was required to access the data collection forms. No identifying information (i.e., names or email addresses) were included on any of the electronic forms. See Table 2 for descriptive statistics of all variables included in the present study.

Procedure

Participants were seated at a desk with a desktop computer, mouse, keyboard, and speakers in a private interview room with a researcher upon arrival to the lab. Informed consent was obtained after explanation of session procedures and the answering of any questions. Researchers followed a scripted manual throughout the course of the session that detailed all session instructions. The participant first completed the Personal Identification Form/Medical History Questionnaire (PIF/MHQ) and State-Trait Anxiety Inventory (STAI) self-report measures, followed by the Center for Epidemiological Studies-Depression Scale Revised (CESD-R), Dysexecutive Functioning Scale (DEX), Alcohol Use Disorders Identification Test (AUDIT), and the Timeline Followback (TLFB). The last of the self-report measures were administered at this time, which included the Brief Young Adult Alcohol Consequences Questionnaire (B-YAACQ), Protective Behavioral Strategies Scale (PBSS-20), and the Positive and Negative Metacognitive Beliefs about Alcohol Scales (PAMS/NAMS). All measures will be described below. Debriefing concluded the session for a total session time of 45 minutes. See Figure 3 for a graphical representation of the participant session.

Measures

Participants completed several computerized self-report measures pertaining to demographics, medical history, executive functioning, alcohol use, and additional psychological variables. See Appendix A for a reproduction of each of the measures.

Personal Identification Form/Medical History Questionnaire (PIF/MHQ). Participants were asked to provide personal demographic information such as biological sex (i.e., male or female) and history of traumatic brain injury. Both biological sex and history of TBI were included as covariates in the analyses. It was expected that history of TBI would negatively

relate to ECF, and that biological sex would be associated with metacognitive beliefs about alcohol.

Center for Epidemiological Studies-Depression Scale Revised (CESD-R; Eaton, Muntaner, Smith, Tein, & Ybarra, 2004). The CESD-R is a 20-item measure that quantifies symptoms of depression across nine domains established by the Diagnostic and Statistical Manual, fourth edition (American Psychiatric Association, 2000). The nine domains assessed via the CESD-R were thought to reflect two major symptom clusters of negative mood and functional impairment (Van Dam & Earleywine, 2011). The answer choices were presented as a Likert scale ranging from 0 to 4 (0 = *Not at all to less than one day*; 1 = *1-2 days*; 2 = *3-4 days*; 3 = *5-7 days*; 4 = *Nearly every day for two weeks*). The total score was calculated as a sum of all 20 responses; however, responses of both 3 and 4 were scored as values of 3 to match the range of scores posited in the initial version (Radloff, 1977). Scores of 16 or greater suggest risk for clinical depression, with higher scores indicating greater risk. The measure has high internal reliability ($\alpha = 0.928$) as well as convergent and divergent validity (Van Dam & Earleywine, 2011). Scores on this measure were utilized as a covariate in the analyses, and were expected to negatively relate to ECF.

State-Trait Anxiety Questionnaire, Trait Subscale (STAI; Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983). The STAI Trait subscale is a 20-item measure that assesses anxiety with 20 questions devoted to levels of trait anxiety. The items were rated on a 1 to 4 Likert scale (1 = *Almost never*; 2 = *Sometimes*; 3 = *Often*; 4 = *Very much so*), with higher scores indicating higher levels of anxiety. The measure has high internal reliability (α = .86-.95), test-re-test reliability (α = .65-.75), construct validity, and concurrent validity (Spielberger et al.,

1983). Scores on this measure were utilized as a covariate in the analyses, and were expected to negatively relate to ECF.

Dysexecutive Functioning Questionnaire (DEX; Wilson, Evans, Alderman, Burgess, & Emslie, 1998). The DEX is a self-rated measure of dysfunctional executive cognitive abilities. The DEX is a 37-item measure with four subscales, each intended to capture four domains: emotional (e.g., "I sometimes get overexcited about things and can be a bit 'over the top' at these times"); motivational ("I am lethargic, or unenthusiastic about things"); cognitive ("I have trouble making decisions, or deciding what I want to do"); and behavioral ("I tend to be restless and 'can't sit still' for any length of time"). The questions were answered on a Likert scale ranging from 1 to 5 (1 = *Never*; 2 = *Occasionally*; 3 = *Sometimes*; 4 = *Fairly often*; 5 = *Very often*), with higher scores associated with an increased severity of executive cognitive functioning. The measure has high reliability (mean α of four subscales= .85) and internal construct validity (Wilson, Evans, Alderman, Burgess, & Emslie, 1998). It was expected that lower ECF would be related to less behavioral strategy use and more alcohol-related consequences.

Positive and Negative Metacognitive Beliefs about Alcohol Scale (PAMS/NAMS; Spada & Wells, 2008). The PAMS/NAMS is an 18-item measure that assesses an individual's motivation to consume alcohol with the belief that consumption will either positively or negatively affect his or her cognitive or emotional state. A positive metacognitive belief about alcohol is operationalized as the motivation to consume alcohol with the expectation that alcohol will serve as a self-regulatory tool (Spada & Wells, 2006a). The PAMS has 12 items consisting of two factors, motivation to consume alcohol for emotional self-regulation and motivation to consume for cognitive self-regulation. A negative metacognitive belief about alcohol is

operationalized as both a perceived lack of control over an individual's ability to regulate alcohol consumption and the expectation that alcohol will negatively impact his or her cognitive or emotional state (Spada & Wells, 2006a). Accordingly, the six-item NAMS consists of two factors, expectation of uncontrollability and cognitive/emotional harm. Items are rated on a 1 to 4 Likert scale (1 = *Do not agree*; 2 = *Agree slightly*; 3 = *Agree moderately*; 4 = *Agree very much*), with higher scores indicative of stronger expectancies pertaining to the consumption of alcohol. The PAMS/NAMS has good internal reliability (mean α of all four factors = .77) and predictive validity (Spada & Wells, 2008). The two PAMS factors have fair test-retest reliabilities (*rho* = .75 for emotional self-regulation; *rho* = .65 for cognitive self-regulation). The NAMS factor of uncontrollability has poor test-retest reliability (*rho* = .42) and the NAMS factor of cognitive/emotional harm has fair test-retest reliability (*rho* = .68) (Spada & Wells, 2008).

The NAMS factor of uncontrollability has been linked to the perpetuation of alcohol use rather than initiation and has been implicated in individuals with alcohol-use disorders (Spada & Wells, 2010). Although this factor has low test-retest reliability, the current sample was expected to exhibit sub-clinical alcohol consumption patterns and thus was not likely to express this factor. A brief screening for alcohol-use disorders with the Alcohol Use Disorders Identification Test (AUDIT; Saunders, Aasland, Amundsen, & Grant, 1993) was included in the current study to confirm this estimation. A score of 8 or above is associated with "hazardous drinking", and a score of 13 or above for women (15 or above for men) is suggestive of a high likelihood of alcohol dependence. Indeed, the average score on the AUDIT in the current study was 7.08, indicating that on average, the sample exhibited sub-hazardous levels of drinking. Furthermore, only twenty-two participants received a score that is suggestive of alcohol dependence. Scores on the PAMS/NAMS were utilized in the analyses, and it was expected that maladaptive

metacognitive beliefs would be related to less behavioral strategy use and more alcohol-related consequences.

Protective Behavioral Strategies Scale-Revised (PBSS-20; Treloar, Martens, & McCarthy, 2015). The PBSS-R is a 20-item questionnaire that quantifies cognitive-behavioral strategies that individuals report to have actively engaged in during acute alcohol consumption in the past 30 days. Implementation of these strategies can be used as an educational tool and may serve to reduce consumption and alcohol-related consequences (Martens, Ferrier, Sheehy, & Corbett, 2005). The PBSS-20 is composed of three subscales developed from factor analyses in the original construction of the PBSS (Martens, Ferrier, Sheehy, & Corbett, 2005; Martens, Pedersen, LaBrie, Ferrier, & Cimini, 2007). The subscales are labeled as Limiting/Stopping Drinking (i.e., strategies related to either slowing down or ceasing consumption), Manner of Drinking (i.e., strategies related to different methods of consumption), and Serious Harm Reduction (i.e., strategies related to avoiding harmful consequences of consumption). Items were reported on a 1 to 6 Likert scale (1 = *Never*; 2 = *Rarely*; 3 = *Occasionally*; 4 = *Sometimes*; 5 = *Usually*; 6 = *Always*), with higher scores indicative of greater use of strategies. The PBSS-20 has good internal reliability (α = .83), test-retest reliability, convergent validity, and construct validity (Martens, Ferrier, Sheehy, & Corbett, 2005; Treloar, Martens, & McCarthy, 2015).

Prospective validity examinations in the original construction of the PBSS and the revised PBSS-20 indicate that the Manner of Drinking subscale had the strongest unique relation to measured drinking outcomes and alcohol-related consequences, while the Limiting/Stopping Drinking subscale only exhibited a unique relation to the drinking outcome of peak number of drinks in one sitting. (Martens, Ferrier, Sheehy, & Corbett, 2005; Treloar, Martens, & McCarthy, 2015). The revised PBSS-20 significantly improved the content validity of the original Serious

Harm Reduction subscale and subsequently improved its prospective validity. Specifically, the revised Serious Harm Reduction subscale is the only one out of the three total subscales examined separately to exhibit significant associations with alcohol-related consequences, with no unique associations with alcohol-use outcomes (Treloar, Martens, & McCarthy, 2015). It was expected that behavioral strategy use would be inversely related to alcohol-related consequences.

Brief Young Adult Alcohol Consequences Questionnaire (B-YAACQ; Kahler, Strong, & Read, 2005). The B-YAACQ is a 24-item measure that quantifies the incidence and severity of alcohol-related consequences over the past 30 days. The B-YAACQ is an abbreviated version of the original 48-item questionnaire (Read, Kahler, Strong, & Colder, 2004). Item responses were *yes* or *no*, with more *yes* responses indicative of a higher number of experienced alcohol-related consequences. The measure has good internal reliability (α = .84) test-retest reliability, prospective validity, and discriminative validity (Kahler, Hustad, Barnett, Strong, & Borsari, 2008). It was expected that a greater number of alcohol-related consequences would be related to less behavioral strategy use and greater ECF deficits.

Alcohol Use Timeline Followback (TLFB; Sobell & Sobell, 1992). The TLFB is a specialized interview that employs a calendar method to gather retrospective estimates of several variables related to alcohol consumption over a specified period of time. Participants in the current study were instructed to report the days in which they consumed alcohol and the quantity of use on those days in terms of standard drinks. These two estimates were used to calculate a single alcohol consumption variable (i.e., drinks per drinking day) for use in the current study that mirrors a commonly-used and standardized method of quantification (see Gmel & Rehm, 2004 for a review). The TLFB obtained information on each these three variables spanning the 30 days prior to the interview. This timeframe is consistent with the extent to which participants

were asked to report use of protective behavioral strategies via the PBSS-20 measure and intensity of alcohol-related consequences via the B-YAACQ measure.

The researcher communicated to the participant how to convert the quantity of alcohol consumed to number of standard drinks and participants had access to a reference sheet to consult throughout the interview as needed (See Figure 2 for reference sheet). The researcher was trained in several techniques aimed to enhance participants' recall of drinking episodes (e.g., pre-emptively identifying memorable dates and events to serve as anchors). Exact day-to-day precision of recall cannot be assumed due to discrepancies stemming from memory biases and intentional underreporting (Greenfield & Kerr, 2008). Even so, the TLFB is a well-validated and reliable measure of self-reported alcohol consumption (Maisto, Conigliaro, Gordon, McGinnis, & Justice, 2008; Sobell, Brown, Leo, & Sobell, 1996). Scores on this measure were utilized as a covariate in the analyses and were expected to positively relate to alcohol-related consequences.

Data Analysis

Quantification of ECF. Executive cognitive function was quantified as a single continuous variable calculated from total scores on the DEX. The DEX was not separately analyzed by subscale due to the conceptualization of ECF as interdependent yet distinct constructs (Nelson & Narens, 1990; Simblett & Bateman, 2011) and with consideration of joint influences of ECF-related abilities linked to alcohol-related consequences. Higher DEX scores indicated lower ECF status.

Quantification of alcohol-related variables. Four alcohol-related variables were used in analyses: Alcohol consumption (i.e., drinks per drinking day), behavioral strategies, metacognitive beliefs about alcohol, and alcohol-related consequences.

Alcohol consumption. The outcome for alcohol consumption was a continuous variable commonly calculated from the TLFB, drinks per drinking day (DDD). DDD was calculated by dividing the number of drinking days by the total number of standard drinks. Alcohol consumption was treated as a co-variate as consumption is only moderately associated with consequences (Mallet, Marzell, & Turrisi, 2011).

Behavioral strategies. Behavioral strategies that individuals may have used during acute alcohol consumption were quantified by the number of behavioral strategies endorsed on the original 20 questions of the PBSS-20. Continuous scores on the three subscales (i.e., Limiting/Stopping Drinking, Manner of Drinking and Serious Harm Reduction) were analyzed separately in relation to their proposed association with alcohol-related consequences. Higher scores were indicative of increased use of behavioral strategies and inversely relate to risk for alcohol-related consequences.

Alcohol-related consequences. The number of reported alcohol-related consequences a participant had experienced in the past 30 days was indicated by categorical, binomial answers on the B-YAACQ. Participants indicted their experience of consequences by responding "yes" or "no" to each question. Scores were summed to calculate a single count variable for analyses. Higher scores related to more experiences of alcohol-related consequences.

Metacognitive beliefs about alcohol. Participants' metacognitive beliefs that alcohol would either positively or negatively affect subsequent cognitive and/or emotional self-regulation was measured by continuous scores on the PAMS and NAMS, respectfully. Scores on the four subscales of the PAMS/NAMS (i.e., Cognitive regulation, Emotional regulation, Uncontrollability, Cognitive harm) were analyzed separately in relation to their proposed association with behavioral strategies and alcohol-related consequences. Higher scores suggested

the presence of more metacognitive beliefs and scores related to risk for alcohol-related consequences.

Path analyses. All path analysis data was analyzed in MPlus 8.1 (Muthén & Muthén, 1998-2012). Moderated mediation models were employed to examine the associations between ECF, behavioral strategies, alcohol-related consequences, and co-variates. Specifically, behavioral strategy scores were entered as mediators between ECF and consequences. Metacognitive beliefs about alcohol scores were entered as moderators on the relationship between ECF and behavioral strategies.

Each of the three subscales of the PBSS-20 (Serious Harm Reduction, Limiting/Stopping Drinking, Manner of Drinking) used to assess behavioral strategies were considered individually in separate models instead of using a total sum score. Each of the four subscales of the PAMS/NAMS (Cognitive Self-regulation, Emotional Self-regulation, Uncontrollability, Cognitive Harm) utilized to assess metacognitive beliefs about alcohol were considered in separate models as well. This manner of analysis resulted in multiple individual models. Alpha inflation occurs when running multiple models; therefore, to account for this bias, direct and indirect effects were assessed using Monte Carlo intervals at the .01 alpha level.

The first stage of building the moderated mediation model for Hypothesis 1 consisted of utilizing a negative binomial regression to determine the association between ECF and consequences. A negative binomial regression was chosen as response options to the B-YACCQ are binary where *yes* was coded as 1 and *no* was coded as 0. Responses were summed as a count variable and were expected to be negatively skewed. To determine the significance of the negative binomial regression analyses, Monte Carlo confidence intervals were exponentiated around each point estimate. The point estimates for the results of each model were converted

from odds ratios to rate ratios to ease interpretation of categorical variables in the model. All subsequent paths leading to consequences were analyzed using this method.

Next, to test Hypothesis 2, each of the three subscales of the PBSS-20 were built into three otherwise identical models to determine if any of the three domains measured by each subscale mediated the relationship between ECF and consequences. Any variable that was regressed on behavioral strategies (i.e., ECF) was analyzed using simple linear regressions. Scores on the PBSS-20 were continuous and were not expected to be skewed; thus, assumptions of normality were met. Indirect effects were measured by examining the Monte Carlo confidence intervals using the product of the coefficients method.

Third, to test Hypothesis 3, each of the four subscales of the PAMS/NAMS were added as possible moderating variables affecting the relationship between ECF and behavioral strategies. Each PAMS/NAMS subscale was added into a separate model. For the same reasoning as directly stated above, the moderating effect of metacognitive beliefs about alcohol on ECF and behavioral strategy use were analyzed using simple linear regressions. The presence of a significant moderating effect was measured by examining the strength of the interaction term.

Lastly, to test the components of Hypothesis 4, the co-variates were included in the models. Alcohol use was regressed onto consequences; depression, anxiety, and history of brain injury was regressed onto ECF; and biological sex was regressed onto metacognitive beliefs about alcohol. Please see Figure 1 below for a representation of these path analyses.

RESULTS

Path Analyses

A series of negative binomial regressions determined the relationship between variables of interest. This method of analysis was chosen because the mean number of experienced alcohol-related consequences (M=4.67) was smaller than the variance (s^2=23.00), thus creating a negative binomial count distribution. In order to interpret results from the logistic regressions, the unstandardized regression coefficients and 95% confidence intervals (CI) of variables directly predicting the outcome variable (i.e., consequences) were transformed to calculate rate ratios (RR). The transformations from odds ratios to rate ratios were calculated by exponentiating the unstandardized regression coefficients within the Mplus 8.1 (Muthén & Muthén, 1998-2012) output. Rate ratios were interpreted as an expected percent change in the outcome variable for one unit change in the predictor variable. Demographics and bivariate correlations pertaining to the path analyses variables are presented in Table 2 and 3, respectively.

Hypothesis 1: Association between ECF and consequences. Results for Hypothesis 1 are presented in Table 4. A negative binomial regression was employed to first determine the association between ECF and alcohol-related consequences without any mediating variables, moderating variables, or co-variates. Results indicate that there was a significant relationship between ECF and consequences. Specifically, for every one unit increase on DEX scores, indicating lower ECF, there was a 2.9 percent increase in the number of consequences experienced. Results indicate that there was a significant negative relationship between ECF and consequences.

Hypothesis 2: Mediation analyses. Scores on the three subscales of the PBSS-20 (i.e., Limiting/Stopping Drinking, Manner of Drinking, and Serious Harm Reduction) were entered into separate path analysis models to test the hypothesis that behavioral strategies mediate the relationship between ECF and alcohol-related consequences. Monte Carlo confidence intervals (MCCI) were calculated to establish if the indirect effects of the mediation paths were significant. Values from the Technical 1 and Technical 3 outputs of each analysis processed through MPlus 8.1 (Muthén & Muthén, 1998-2012) were inputted into an interactive online tool to calculate Monte Carlo confidence intervals (http://www.quantpsy.org/medmc/medmc.htm; Selig & Preacher, 2008). These MCCI values were then exponentiated to convert from odds ratios to rate ratios to ease interpretation.

Limiting/Stopping Drinking (LSD) subscale. Transformed unstandardized regular coefficients and 95% CI show significant direct effects, such that for every one unit increase in DEX scores, indicating lower ECF, there was a 3% increase in experienced consequences. Transformed MCCI values indicate that the indirect effects of this model were not significant, indicating that behavioral strategies that aimed to limit or stop drinking did not significantly mediate the association between ECF and consequences.

Manner of Drinking (MoD) subscale. Transformed unstandardized regular coefficients and 95% CI show significant direct effects, such that for every one unit increase in DEX scores, indicating lower ECF, there was a 2% increase in experienced consequences. Transformed MCCI values show that the indirect effects of this model were not significant, indicating that behavioral strategies that aimed to change the manner of drinking did not significantly mediate the association between ECF and consequences.

Serious Harm Reduction (SHR) subscale. Transformed unstandardized regular coefficients and 95% CI show significant direct effects, such that for every one unit increase in DEX scores, indicating lower ECF, there was a 3% increase in experienced consequences. Transformed MCCI values show that the indirect effects of this model were not significant, indicating that behavioral strategies that aimed to change the manner of drinking did not significantly mediate the association between ECF and consequences.

Summary of mediation analyses for Hypothesis 2. Results for Hypothesis 2 are presented in Tables 5-7. Three negative binomial regressions determined if the use of behavioral strategies mediated the relation between ECF and consequences. Each subscale of the PBSS-20 to measuring behavioral strategies were utilized in a separate model. Direct effects of each of the three mediation analyses were significant, and indirect effects of each were insignificant. Although not significant, the results were in the expected direction for the Limiting/Stopping Drinking and Manner of Drinking subscales, such that lower ECF was associated with more behavioral strategy use and less endorsement of consequences. Overall, these results indicate that behavioral strategy use does not significantly mediate the relation between ECF and consequences.

Hypothesis 3: Moderated mediation analyses. Scores on each of the two subscales of the PAMS (i.e., emotional regulation and cognitive regulation) and the NAMS (i.e., uncontrollability and cognitive harm) were added separately into each of the three negative binomial regression models described in the previous subsection, for a total of twelve moderated mediation models. The Mplus code used for this part of the analysis was based on previously established documentation (Hayes, 2013; Stride, Gardner, Catley, Thomas, 2015). Monte Carlo confidence intervals (MCCI) were calculated for any moderation variables with a significant *p*-

value to establish if the indirect effects of the moderated mediation paths were significant. Values from the Technical 1 and Technical 3 outputs of each analysis processed through MPlus 8.1 (Muthén & Muthén, 1998-2012) were inputted into an interactive online tool to calculate Monte Carlo confidence intervals (http://www.quantpsy.org/medmc/medmc.htm; Selig & Preacher, 2008). These MCCI values were then exponentiated to convert from odds ratios to rate ratios to ease interpretation.

The following subsections report whether metacognitive beliefs about alcohol significantly moderated the association between ECF and behavioral strategies, and if the interactions related to the experience of consequences.

Positive metacognitive beliefs about alcohol: Cognitive Regulation. In models with PBS subscales of Serious Harm Reduction, Limiting/Stopping Drinking, and Manner of Drinking as mediating variables, significant direct effects existed between ECF and alcohol-related consequences. In models with subscales of Limiting/Stopping Drinking and Manner of Drinking as mediating variables, a significant effect existed between the mediating variables and alcohol-related consequences. No other results were significant, including any indirect effects of the moderating variable. Results indicate that the PAMS subscale of Cognitive Regulation did not significantly moderate the relationship between ECF, behavioral strategies, and consequences.

Positive metacognitive beliefs about alcohol: Emotional Regulation. In the models with PBS subscales of Serious Harm Reduction, Limiting/Stopping Drinking, and Manner of Drinking as mediating variables, significant direct effects existed between ECF and alcohol-related consequences. In models with subscales of Limiting/Stopping Drinking and Manner of Drinking as mediating variables, a significant effect existed between mediating variables and alcohol-related consequences. No other results were significant, including any indirect effects of

the moderating variable. Results indicate that the PAMS subscale of Emotional Regulation did not significantly moderate the relationship between ECF, behavioral strategies, and consequences.

Negative metacognitive beliefs about alcohol: Uncontrollability. In models with PBS subscales of Serious Harm Reduction, Limiting/Stopping Drinking, and Manner of Drinking as mediating variables, significant direct effects existed between ECF and alcohol-related consequences. In models with subscales of Limiting/Stopping Drinking and Manner of Drinking as mediating variables, a significant effect existed between mediating variables and alcohol-related consequences. No other results were significant, including any indirect effects of the moderating variable. Results indicate that the NAMS subscale of Uncontrollability did not significantly moderate the relationship between ECF, behavioral strategies, and consequences.

Negative metacognitive beliefs about alcohol: Cognitive Harm. In the models with PBS subscales of Serious Harm Reduction, Limiting/Stopping Drinking, and Manner of Drinking as mediating variables, significant direct effects existed between ECF and alcohol-related consequences. In models with the subscales of Limiting/Stopping Drinking and Manner of Drinking as mediating variables, a significant effect existed between mediating variables and alcohol-related consequences.

A significant interaction existed in the model with PBS-Manner of Drinking, such that the relationship between ECF and behavioral strategies varied at different levels of metacognitive beliefs about the cognitive harm of drinking. Specifically, a significant interaction occurred at high levels of the moderating variable (i.e., Cognitive Harm). Low and medium levels of the moderating variable did not reach statistical significance.

No other results were significant from the remaining two models. Results indicate that the NAMS subscale of Cognitive Harm significantly moderated the relationship between ECF, Manner of Drinking behavioral strategies, and consequences.

Summary of moderated mediation models for Hypothesis 3. Results for Hypothesis 3 are presented in Tables 8-19. Twelve negative binomial regressions determined if metacognitive beliefs about alcohol moderated the relationship between behavioral strategies, ECF and consequences. Each of the four subscales of the PAMS/NAMS (i.e., PAMS-Cognitive Regulation, PAMS-Emotional Regulation, NAMS-Uncontrollability, NAMS-Cognitive Harm) and each of the three subscales of the PBSS-20 (i.e., Serious Harm Reduction, Limiting/Stopping Drinking, and Manner of Drinking) were inputted into separate models that tested the twelve possible combinations.

Direct effects of all twelve analyses were significant. The direct effect between the mediating variables and consequences were also significant in all models except those which had PBS-Serious Harm Reduction as the mediator. Finally, out of the twelve tested moderated mediation models, one interaction was significant. At high levels of the moderator PAMS-Cognitive Harm, PBS-Manner of Drinking significantly mediated the relation between ECF and alcohol-related consequences. No other moderating effects were found to be significant.

Overall, these results indicate that the ability of Manner of Drinking behavioral strategies to mediate the relation between ECF and consequences depends on a high endorsement of metacognitive beliefs about cognitive harm. No other metacognitive beliefs about alcohol relate to the link between ECF, behavioral strategies, and alcohol-related consequences.

Hypothesis 4: Analyses with co-variates added. Biological sex, history of TBI, drinks per drinking day (i.e., DDD), CESD-R scores, and STAI scores were added into the negative

binomial regression model with NAMS-Cognitive Harm as the moderator and PBS-Manner of Drinking as the mediator, as described in the previous subsection. Monte Carlo confidence intervals (MCCI) were calculated for any predictor variables with a direct relationship with alcohol-related consequences to establish statistical significance. Values from the Technical 1 and Technical 3 outputs of each analysis processed through MPlus 8.1 (Muthén & Muthén, 1998-2012) were inputted into an interactive online tool to calculate Monte Carlo confidence intervals (http://www.quantpsy.org/medmc/medmc.htm; Selig & Preacher, 2008). These MCCI values were then exponentiated to convert from odds ratios to rate ratios for ease of interpretation.

Results suggest that both depression and anxiety were positively associated with ECF, while history of TBI was not significantly related in any way. These findings partially support the hypotheses that all three co-variates would be associated with ECF. Biological sex was not related to metacognitive beliefs about alcohol, which opposed the hypothesis that females would exhibit more positive metacognitive beliefs than males. Results suggest that the type of metacognitive belief was not dependent on biological sex. Lastly, the relationship between drinks per drinking day (DDD) was significantly and positively related to alcohol-related consequences, which was in line with the posited hypothesis.

The direct effect of ECF on alcohol-related consequences remained statistically significant with the inclusion of the co-variates. Specifically, for every one unit increase in DEX scores, indicating lower ECF, there was a 2.3% increase in the number of consequences experienced. The association between PBS-Manner of Drinking and alcohol-related consequences remained significant as well. For every one unit increase in PBS-Manner of Drinking scores, indicating more behavioral strategy use, there was a 7% decrease in the number

of experienced alcohol-related consequences. Finally, the effect of NAMS-Cognitive Harm remained statistically significant at high levels of the moderator. Indirect effects suggest that for every one unit increase in scores on this subscale (i.e., greater belief that alcohol will result in cognitive harm), there was a 0.9% increase in the use of behavioral strategies.

Summary of Results

Results support Hypothesis 1 in that ECF was significantly related to consequences, such that lower ECF was associated with endorsement of a greater number of negative consequences from alcohol use. Hypothesis 2 was not supported; although both the direct relationship between ECF and negative consequences, and between the mediating variables (excluding the PBS-Serious Harm Reduction subscale) and consequences, reached statistical significance. Results suggest behavioral strategies do not mediate the relation between ECF and negative consequences. Hypothesis 3 was partially supported. A significant moderated mediation was detected with NAMS-Cognitive Harm as the moderating variable and PBS-Manner of Drinking as the mediating variable. At high levels of metacognitive beliefs about Cognitive Harm, there is a significant interaction to support the mediation between ECF, Manner of Drinking behavioral strategy use, and negative consequences. No other moderated mediation model reached statistical significance. Lastly, Hypothesis 4 was partially supported such that scores on CESD-R and STAI were inversely related to ECF, and DDD positively related to alcohol-related consequences. The moderated mediation found between ECF, NAMS-Cognitive Harm, PBS-Manner of Drinking, and alcohol-related consequences remained statistically significant even with the inclusion of co-variates. This finding suggests that the primary variables included in the model were predicative of alcohol-related consequences over and above the co-variates.

DISCUSSION

The prevalence of alcohol-related negative consequences in college populations is an enduring problem, and has encouraged researchers to develop interventions in an effort to decrease the incidence of these outcomes. Previous studies have shown that beliefs or expectations regarding how alcohol will affect internal states or external situations act as motivational factors to either drink or not to drink. Students who believe that alcohol use is associated with positive outcomes may be motivated to continue problematic drinking patterns, while students who believe that alcohol use will result in negative experiences may be encouraged to change these patterns in favor of healthier outcomes. Further studies demonstrated that behavioral strategies play a significant role in the relationship between beliefs and negative outcomes from drinking. Research in this area revealed that the use of behavioral strategies mediates the relationship between beliefs and alcohol-related consequences.

Despite the wealth of research investigating antecedents of alcohol-related consequences in college populations, there is currently a lack of applied interventions effectively reducing these consequences. The current study addressed this deficiency by examining the significance of cognition in the previously-established connection between behavioral strategies and alcohol-related consequences. Past research suggests that executive cognitive functions such as self-regulation and working memory are associated with strategy use and alcohol-related consequences. The current study built on these findings by employing the DEX, a scale that encompasses more areas of ECF than previously explored, rather than a measure that hones in on one specific subdomain of ECF. Results of the current study supported the first hypothesis, in that ECF was inversely related to the number of endorsed alcohol-related consequences.

Specifically, for every one-unit increase in DEX scores, indicating lower ECF, there was a 2.9 percent increase in the number of negative consequences students experienced.

The DEX is a rating scale designed to measure behavioral manifestations of cognitive impairment which negatively affects day-to-day functioning, such as impulsivity, disregard for social conventions, apathy, perseveration, and compulsive jocularity (Bodenburg & Dopslaff, 2008). To assess these areas of dysfunction, the DEX employs items that sample four domains: emotional (e.g., "I sometimes get overexcited about things and can be a bit 'over the top' at these times"); motivational ("I am lethargic, or unenthusiastic about things"); cognitive ("I have trouble making decisions, or deciding what I want to do"); and behavioral ("I tend to be restless and 'can't sit still' for any length of time"). This measure differs from those used in previous research by assessing a range of executive cognitive functions in one scale, thus eliminating the need to expend multiple scales or tasks for different subdomains of cognitive ability. In this way, using the DEX may reduce the amount of statistical power needed for analyses compared to using multiple measures of ECF.

The significant association between DEX scores and alcohol-related consequences suggests that previously examined ECF subdomains of self-regulation and working memory are not the only elements related to negative outcomes from drinking. This finding corresponds with the idea that ECF is a range of skills composed of interdependent constructs allowing the ability to formulate, initiate and regulate goal-directed behaviors (Giancola, Martin, Tartar, Pelham & Moss, 1996; Foster, Eskes & Stuss, 1994; Nelson & Narens, 1990, Simblett & Bateman, 2011). The broad areas of cognitive-behavioral assessment encompassed by the DEX encapsulates how ECF connects to alcohol-related consequences, including but not limited to the subdomains of self-regulation and working memory.

Executive cognitive function is implicated in proficiently making appropriate decisions by means of choosing and implementing optimal behavioral strategies according to situational context (Fisk & Sharp, 2004; Miyake et al., 2000). The items included in the DEX fit well with this perspective; the scale intends to highlight behavioral dysfunction relating to cognitive impairment. The finding that the DEX is associated with alcohol-related consequences suggests that decision making processes needed to choose suitable behavioral patterns may be central in students' ability to implement appropriate strategies. Thus, the second hypothesis of the current study was aimed at determining the relationship between ECF (as measured by DEX scores), behavioral strategies, and the experience of alcohol-related consequences. It was expected that behavioral strategy use would mediate the association between ECF and consequences of drinking. However, results did not support this hypothesis. Although a significant direct association remained between ECF and consequences, findings suggest that none of the three subdomains of behavioral strategy use as measured by the PBSS-20 (i.e., Limiting/Stopping Drinking, Manner of Drinking, or Serious Harm Reduction) mediated this relationship.

There are various explanations for the finding that behavioral strategies did not mediate the association between ECF and consequences. While DEX scores were inversely linked to the experience of negative consequences, it is possible that there are subdomains of ECF that more specifically connect with strategy use than others. Previous studies have found a significant link between self-regulation, strategy use, and consequences (Doumas, Miller, & Esp, 2017). It may be the case that self-regulatory abilities are more directly associated with the capacity to implement strategies, while other domains of ECF help reduce negative consequences through different outlets. As examples, attentional networks (Lannoy et al., 2017) and working memory have been linked to problematic drinking patterns, although these constructs have yet to be

examined in the context of behavioral strategies or alcohol-related consequences. This supposition parallels the "balance model" of problematic drinking behavior, which posits that specific patterns of strengths and weaknesses in an executive functioning network affect behavioral decision making, rather than the idea that ECF deficits overall affect behavioral control (Whitney, Hinson, & Jameson, 2006). While ECF appears to play a role in experiencing negative outcomes from drinking, perhaps weaknesses in self-regulatory and long-term goal-directed behavior are more important considerations than other domains of cognition regarding the ability to engage in strategy use.

If this contention holds true, it may be more prudent for future studies intending to reduce consequences through behavioral strategy use to continue focusing on self-regulatory-related functioning rather than ECF as a whole. To date, behavioral strategy use is the most consistently linked predictive antecedent of alcohol-related consequences, while self-regulation has been consistently linked to strategy usage. Perhaps impulse control skills training would positively affect the success of applied interventions assessing behavioral strategy use and the experience of consequences. This type of exercise may especially benefit college students, who are still going through structural and functional changes in the brain linked to self-regulatory abilities. For instance, the nucleus accumbens, a brain region associated with anticipatory pleasure and reward seeking, matures faster in adolescents and young adults than the ventral prefrontal cortex, a region connected to impulse inhibition (Bava & Tapert, 2010; Casey, Getz, & Galvan, 2008). A focus on compensating for specific cognitive deficits which impair the ability to implement appropriate behavioral strategies may overcome the lack of reduction in consequences in applied interventions.

Previous research has linked ECF (i.e., self-regulation, working memory) to behavioral strategy use and consequences, though these studies also incorporated individual's expectations/beliefs about alcohol use into this equation. Bravo, Prince, and Pearson (2015) reported that behavioral strategies mediated the association between alcohol expectations/beliefs and negative outcomes from drinking, and that self-regulatory abilities were a significant antecedent of this relationship. Hypothesis 2 of the current study stated that behavioral strategies would mediate the relationship between ECF and consequences without taking expectations/beliefs into account. It is possible that ECF does not have a direct association with behavioral strategies, and is fully dependent on the indirect effects of expectations/beliefs of the effects of alcohol. If accurate, this postulation could explain why the mediation models in the current study did not attain statistical significance. Hypothesis 2 may have been incompatible with results due to either an unnecessary focus on ECF overall instead of only self-regulatory or impulsivity-related functions, or because ECF more directly relates to alcohol expectations/beliefs than it does behavioral strategy use. Hypothesis 3 endeavored to address the latter idea.

Hypothesis 3 built upon Hypotheses 1 and 2. ECF was expected to be associated with alcohol-related consequences, and behavioral strategies mediated this relationship, but metacognitive beliefs about alcohol were considered here as well. Specifically, a moderated mediation was suggested such that metacognitive beliefs about alcohol would moderate the relationship between ECF and behavioral strategies, which in turn would link to experienced consequences. Co-variates of history of TBI, depression, anxiety, biological sex, and DDD were added to the models to form Hypothesis 4. Twelve moderated mediation models were performed to account for the twelve possible combinations between the three subscales of the PBSS-20 and

the four subscales of the PAMS/NAMS to measure behavioral strategy use and positive/negative metacognitive beliefs about alcohol, respectfully. In all twelve models, there was a significant direct association between ECF and alcohol-related consequences, while none of the co-variates significantly altered the outcomes of the models. However, only one of the moderated mediation models evoked statistically significant indirect effects. Particularly, high negative metacognitive beliefs about cognitive harm significantly moderated the association between ECF and behavioral strategies pertaining to changing one's manner of drinking, which in turn related to negative outcomes from drinking. This moderated mediation was not significantly related to consequences at low or average levels of negative metacognitive beliefs about cognitive harm. Behavioral strategies were a significant mediator between ECF and alcohol-related consequences only at high levels of metacognitive beliefs about cognitive harm. At low and average levels, ECF still significantly related to consequences, but not via behavioral strategies.

Negative metacognitive beliefs about cognitive harm (NAMS-Cognitive Harm) refer to beliefs that alcohol use will have a negative effect on one's cognitive functioning (Spada & Wells, 2008). Items included in the subscale include, "If I cannot control my drinking I will cease to exist"; "Drinking will damage my mind"; and "Drinking will make me lose control." This subscale differs from the other NAMS component of Uncontrollability in that the items in the Uncontrollability subscale suggest a passive acceptance that there is a lack of executive control over drinking (e.g., I have no control over my drinking"; "Drinking controls my life"). The NAMS-Cognitive Harm subscale instead aimed to capture a more proactive acknowledgement and action plan rather than simply resigning to expected negative outcomes from drinking.

It was expected that NAMS-Cognitive Harm would be negatively associated with strategy use; students with expectations that alcohol will negatively affect cognitive functioning may have been motivated to implement strategies to decrease the chance of unfavorable outcomes. The NAMS-Cognitive Harm subscale significantly moderated the association between ECF and behavioral strategy use, such that high ECF and high metacognitive beliefs about the cognitive harm of drinking were related to more strategy use and less alcohol-related consequences. However, there was no significant interaction at low or average levels of metacognitive beliefs about cognitive harm. This distinction suggests that only excessive expectations/beliefs that alcohol would negatively affect cognitive functioning motivated students to employ behavioral strategies to combat consequences of drinking. Furthermore, it appeared that ECF as measured by the DEX was not associated with behavioral strategy use on its own, but it was when in conjunction with metacognitive beliefs about alcohol. Future studies would benefit from considering the interaction of metacognitive beliefs and ECF while exploring antecedents to strategy use, especially when using a broad measure of ECF as in the current study.

While there was a significant interaction between ECF and NAMS-Cognitive Harm as a predictor of behavioral strategy use, this result was true only with the Manner of Drinking subscale (PBS-MoD) in the model. The items in the Manner of Drinking subscale represent strategies that students can implement and engage in relation to different methods of consumption with the specific goal of controlling alcohol-related consequences. Many of the items in this subscale are avoidance-related, including the following: “Avoid drinking games”; “Avoid mixing different types of alcohol”; “Drink slowly, rather than gulp or chug”; “Avoid trying to keep up or out-drink others”; and “Avoid ‘pre-gaming’ (i.e., drinking before going

out)". Previous studies have identified this subscale as a strong predictor of negative outcomes from drinking (Martens, Ferrier, Sheehy, & Corbett, 2005; Treloar, Martens, & McCarthy, 2015). Strong beliefs and expectations that alcohol would negatively affect cognitive functioning prompted action plans specific to avoiding such an outcome. This finding mirrors research by McEvoy, Moulds, and Mahoney (2013). The authors reported that metacognitive beliefs specifically about the danger and harm of repetitive thinking were robustly related to behavioral strategies aimed to avoid negative thoughts. This finding, together with the results of the current study, suggest that metacognitive beliefs about harm should be especially considered as motivators to implement behavioral change when attempting to control negative outcomes.

Overall, the current study found a significant association between ECF and alcohol-related consequences, such that higher ECF deficits related to more instances of consequences. Behavioral strategies were expected to act as a mediator between ECF and consequences, but such was not the case. However, when metacognitive beliefs about alcohol were added into the model, there was a significant interaction between metacognitive beliefs and ECF which predicted behavioral strategy use and subsequent consequences. Specifically, high levels of metacognitive beliefs about the cognitive harm from drinking interacted with high ECF to predict a greater use of behavioral strategies to change the manner of drinking. No other subscale of the PAMS/NAMS significantly interacted in this way. This study was the first to establish links between metacognitive beliefs about alcohol, ECF, behavioral strategy use and alcohol-related consequences. It is prudent to consider ECF and metacognitive beliefs as antecedents to behavioral strategy use when considering avenues to reduce negative outcomes from drinking.

Limitations

There were limitations that should be considered in the interpretation of the results of the current study. This sample had a low mean number of reported alcohol-related consequences (M=4.67, SD=4.79). This total limits the ability to generalize the findings to students who experience a relatively low number of consequences. It may be the case that ECF and metacognitive beliefs about alcohol have a more robust relationship with negative outcomes than demonstrated in this study, but only in individuals who have more problematic drinking patterns. Future studies would benefit from exploring this association in those with more alcohol-related negative consequences.

The low number of alcohol-related negative consequences in the current study may have been an effect of including students who have not had any drinks in the 30 days prior to testing. The study excluded students who have had no lifetime alcohol use as these individuals would not have experienced consequences from drinking. Thirteen students, or 18.6% of the study sample, reported no lifetime use of alcohol, resulting in a final N of 210. However, thirty-nine additional students included in the study reported no alcohol use in the last 30 days per the Timeline Followback interview. The B-YAACQ, used to assess alcohol-related consequences, asks students to report experienced outcomes within the past 30 days prior to testing. Students who did not drink in the past 30 days should not have experienced any consequences from personal use of alcohol. Excluding these thirty-nine additional students would have, in theory, increased the number of consequences for the overall sample. Indeed, excluding these students would have increased the mean B-YAACQ score to 5.36 (SD=4.87). Furthermore, excluding these students may have affected reported behavioral strategy use and metacognitive beliefs about alcohol. A larger sample size would help to determine if this small increase in consequences would have had a significant effect on results.

Finally, the current study did not consider non-cognitive factors, other than the chosen co-variates, that may have affected the experience of alcohol-related consequences in college students. There are various other circumstances that may interact with cognitive status and metacognitive beliefs about alcohol that could suggest a key relationship with negative consequences from drinking, such as social loneliness and family history of alcohol use. Future studies would benefit from a more holistic examination of antecedents to problematic alcohol use.

Future Directions

A number of future directions have been alluded to throughout the discussion, but two more should be addressed. This study implemented a moderated mediation model to assess the relationship between ECF, metacognitive beliefs about alcohol, behavioral strategy use and alcohol-related consequences. The overall aim was to test whether ECF and metacognitive beliefs had an effect on behavioral strategy use, and if strategy use had an effect on consequences. However, the design of the current study constrained the interpretation of the results. All data was collected concurrently in one laboratory session. A concurrent mediation model has a much more limited ability to suggest the causal effects of one variable on another compared to a longitudinal mediation model (Jose, 2016). A longitudinal study takes into account that the causal relationship between two or more variables takes time to develop and may not happen instantaneously (Selig & Preacher, 2009). With this shortcoming in mind, replication of the current study with longitudinal data would better substantiate the claim that these variables are indeed causally related, and predicative of alcohol-related consequences. Specifically, data pertaining to ECF and metacognitive beliefs for the predictor should be gathered prior to data about behavioral strategies, and then data targeting consequences should

be gathered. In this way, there would be greater evidence that ECF and metacognitive beliefs are predictors of strategy use, which in turn, should be a predictor of negative outcomes from drinking.

Finally, the overarching purpose of the study was to offer a possible solution to the current lack of applied interventions that decrease alcohol-related consequences. A number of studies conducted in less applied research have shown promise, but have not significantly reduced consequences when tested in real-world settings. This study theoretically suggests that ECF and metacognitive beliefs relate to behavioral strategies and consequences in a meaningful way. On its own, the finding adds to the current understanding of the antecedents to alcohol-related consequences, but it has yet to be seen if targeting ECF and metacognitive beliefs have real-world impacts on reducing negative outcomes from drinking. The most important next step would be to test this model in an applied setting aimed to reduce consequences in college students. Future studies should implement ECF and metacognitive beliefs interventions in college students with problematic drinking patterns to determine if this avenue is worth pursuing.

Table 1

Terms and Definitions Used Throughout the Introduction

Term	Definition	Example
Problematic alcohol use	A hazardous pattern of alcohol consumption that negatively impacts an individual's health or day-to-day-life.	"Heavy episodic" drinking (five or more drinks in one sitting for males, four or more for females)
Alcohol-related consequences/outcomes/events	The experiences resulting from alcohol consumption. These may be positive or negative.	- Positive: Social belonging, enhanced emotional state - Negative: Physical or sexual assault, academic difficulties
Alcohol expectations and beliefs	Any anticipated outcome that results from drinking alcohol. These may be positive or negative.	- Positive: "If I drink, then I will feel less depressed." - Negative: "If I drink, I am more likely to miss work tomorrow."
Metacognitive beliefs	The believed significance of thoughts, emotions, or cognitive competence, and the knowledge of potential strategies to cope with such beliefs. These beliefs may be positive or negative (see below).	- Believed significance of thoughts, emotions, or cognitive competence: "Having thought X means I'm weak" - Knowledge of potential coping strategies: "Ruminating will help me find a solution"
Positive metacognitive beliefs about alcohol	The perceived effect of drinking on problem-solving ability, thought control, attention regulation, and self-image regulation.	"Drinking makes me think more clearly"; "Drinking helps me to control my thoughts"; "Drinking helps me focus my mind" "Drinking reduces my self-consciousness", respectively
Negative metacognitive beliefs about alcohol	The perceived lack of executive control over alcohol consumption and the perceived cognitive cost of drinking.	"My drinking persists no matter how I try to control it"; "Drinking will damage my mind", respectively
Behavioral strategies	Cognitive-behavioral strategies that individuals actively engage in, in an effort to decrease alcohol-related consequences.	Leaving a bar/party at a predetermined time, avoiding drinking games, making sure to go home with a friend
Self-regulation	The engagement in goal-related behaviors associated with the promotion of long term values; related to self-control.	Checking progress towards a goal, searching for solutions to problems
Executive cognitive function (ECF)	A set of cognitive skills essential for the ability to formulate, initiate and regulate goal-directed behaviors by utilizing external and internal feedback to adaptively modulate future decisions.	Set-shifting, information updating and monitoring, inhibition of pre-potent responses
Working memory	A facet of ECF that is essential for accurate decision making.	Perception of aspects about a situation, incorporating knowledge from prior experiences, determining how to respond appropriately

Table 2

Demographics

Variable Name	Percent	Mean	Standard Deviation	Range	Minimum	Maximum	Standard Error of Mean	Variance
Age	-	20.08	1.62	12.22	18.44	30.65	.12	2.64
Biological Sex		-	-	-	-	-	-	0.2
Female	59.05							
Male	40.95							
Race		-	-	-	-	-	-	2.85
White	80.9							
Asian	6.2							
Black or African American	3.1							
Native American or Alaskan Native	2.0							
Native Hawaiian or Pacific Islander	1.0							
More than one	2.6							
Do not wish to respond	4.2							
Ethnicity		-	-	-	-	-	-	0.17
Hispanic or Latino	18.6							
Not Hispanic or Latino	80.3							
Do not wish to respond	1.1							
Academic Year		-	-	-	-	-	-	0.88
Freshman	59.3							
Sophomore	26.3							
Junior	7.2							
Senior	6.2							
Other	1.0							
Overall GPA (Out of 4.0)	-	3.15	0.53	2.70	1.60	4.00	.04	0.29
History of Traumatic Brain Injury	59.52							
Yes	40.48	-	-	-	-	-	-	0.2
No								
AUDIT Score	-	7.08	4.97	28	0	28	0.34	24.7
Drinks per Drinking Day	-	3.66	3.42	28	0	28	0.24	11.7
DEX Score	-	23.30	9.73	51	3	54	0.67	94.6
CES-D Score	-	8.81	5.73	27	0	27	0.40	32.8
STAI Score	-	42.01	11.50	55	21	76	0.79	133.2
PBSS-20 Score								
Total		84.30	17.94	95	20	115	1.24	321.7
Limiting/Stopping Drinking subscale	-	24.35	7.91	34	7	41	0.55	62.6
Manner of Drinking Subscale		18.55	5.94	25	5	30	0.41	35.3
Serious Harm Reduction subscale		41.40	7.68	40	8	48	0.53	58.9
PAMS Score								
Total	-	25.43	7.03	36	12	48	0.49	49.4
Cognitive Regulation subscale		5.48	2.03	12	4	16	0.14	4.1
Emotional Regulation subscale		19.96	5.65	24	8	32	0.39	31.9
NAMS Score								
Total	-	8.35	2.36	11	6	17	0.16	5.6
Cognitive Harm subscale		5.07	2.07	9	3	12	0.14	4.3
Uncontrollability subscale		3.28	0.90	6	3	9	0.06	0.8
B-YAACQ Score	-	4.67	4.79	23	0	23	0.33	23.0

Table 3

Model Results for Alcohol-related Consequences on Executive Cognitive Function (ECF)

Variable	RR	S.E.	*p*-value
ECF	1.029	0.008	0.000

Table 4

Model Results for Variables Predicting Alcohol-related Consequences via PBS-Serious Harm Reduction (SHR)

Variables	RR/b	S.E.	*p*-value	MCCI
Consequences on				
ECF	1.030	0.008	0.000	
PBS-SHR	1.006	0.013	0.631	
PBS-SHR on				
ECF	-0.080	0.054	0.139	
Indirect Effect	.999	0.001	0.648	[0.996, 1.009]

Table 5

Model Results for Variables Predicting Alcohol-related Consequences via PBS-Limiting/Stopping Drinking (LSD)

Variables	RR/b	S.E.	*p*-value	MCCI
Consequences on				
ECF	1.028	0.008	0.001	
PBS-LSD	0.977	0.011	0.028	
PBS-LSD on				
ECF	-0.053	0.056	0.343	
Indirect Effect	1.001	0.001	0.384	[0.999, 1.011]

Table 6

Model Results for Variables Predicting Alcohol-related Consequences via PBS-Manner of Drinking (MoD)

Variables	RR/b	S.E.	*p*-value	MCCI
Consequences on				
ECF	1.023	0.008	0.003	
PBS-MoD	0.934	0.013	0.000	
PBS-MoD on				
ECF	-0.061	0.042	0.144	
Indirect Effect	1.004	0.003	0.160	[0.999, 1.018]

Table 7

Model Results for Moderated Mediation via PBS-Serious Harm Reduction (SHR), by PAMS-Cognitive Regulation (COG)

Variables	RR/b	SE	*p*-value
Consequences on			
ECF	1.006	0.03	0.49
PBS-SHR	1.030	0.33	0.65
PBS-SHR on			
ECF	0.02	0.01	0.15
PAMS-COG	-0.06	0.02	0.05
PAMS-COG x ECF	0.01	0.002	0.05
Indirect Effect			
Low PAMS-COG	0.002	0.005	0.73
Med PAMS-COG	0.00	0.004	0.91
High PAMS-COG	-0.001	0.005	0.84

Table 8

Model Results for Moderated Mediation via PBS-Limiting/Stopping Drinking (LSD), by PAMS-Cognitive Regulation (COG)

Variables	RR/b	SE	*p*-value
Consequences on			
ECF	0.977	0.011	0.028
PBS-LSD	1.029	0.008	0.001
PBS-LSD on			
ECF	0.163	0.126	0.194
PAMS-COG	-0.194	0.658	0.768
PAMS-COG x ECF	-0.026	0.020	0.178
Indirect Effect			
Low PAMS-COG	-0.002	0.002	0.363
Med PAMS-COG	0.000	0.001	0.744
High PAMS-COG	0.001	0.002	0.613

Table 9

Model Results for Moderated Mediation via PBS-Manner of Drinking (MoD), by PAMS-Cognitive Regulation (COG)

Variables	RR/b	SE	*p*-value
Consequences on			
ECF	0.934	0.013	0.49
PBS-MoD	1.023	0.008	0.65
PBS-MoD on			
ECF	0.056	0.094	0.15
PAMS-COG	-0.415	0.493	0.05
PAMS-COG x ECF	-0.012	0.015	0.05
Indirect Effect			
Low PAMS-COG	-0.001	0.004	0.773
Med PAMS-COG	0.001	0.003	0.852
High PAMS-COG	0.002	0.003	0.529

Table 10

Model Results for Moderated Mediation via PBS-Serious Harm Reduction (SHR), by PAMS-Emotional Regulation (EMO)

Variables	RR/b	SE	*p*-value
Consequences on			
ECF	1.006	0.013	0.631
PBS-SHR	1.030	0.008	0.000
PBS-SHR on			
ECF	0.045	0.185	0.809
PAMS-EMO	0.165	0.241	0.493
PAMS-EMO x ECF	-0.006	0.009	0.476
Indirect Effect			
Low PAMS-EMO	0.000	0.001	0.713
Med PAMS-EMO	0.000	0.001	0.649
High PAMS-EMO	-0.001	0.002	0.646

Table 11

Model Results for Moderated Mediation via PBS-Limiting/Stopping Drinking (LSD), by PAMS-Emotional Regulation (EMO)

Variables	RR/b	SE	*p*-value
Consequences on			
ECF	0.974	0.011	0.028
PBS-LSD	1.028	0.008	0.001
PBS-LSD on			
ECF	0.246	0.187	0.189
PAMS-EMO	0.074	0.244	0.761
PAMS-EMO x ECF	-0.013	0.009	0.134
Indirect Effect			
Low PAMS-EMO	-0.001	0.002	0.480
Med PAMS-EMO	0.000	0.001	0.766
High PAMS-EMO	0.002	0.002	0.275

Table 12

Model Results for Moderated Mediation via PBS-Manner of Drinking (MoD), by PAMS-Emotional Regulation (EMO)

Variables	RR/b	SE	*p*-value
Consequences on			
ECF	0.934	0.013	0.000
PBS-MoD	1.023	0.008	0.003
PBS-MoD on			
ECF	0.165	0.135	0.220
PAMS-EMO	-0.117	0.176	0.505
PAMS-EMO x ECF	-0.009	0.006	0.150
Indirect Effect			
Low PAMS-EMO	-0.002	0.004	0.529
Med PAMS-EMO	0.001	0.003	0.688
High PAMS-EMO	0.005	0.004	0.209

Table 13

Model Results for Moderated Mediation via PBS-Serious Harm Reduction (SHR), by NAMS-Uncontrollability (UNC)

Variables	RR/b	SE	*p*-value
Consequences on			
ECF	1.006	0.013	0.631
PBS-SHR	1.030	0.008	0.000
PBS-SHR on			
ECF	-0.055	0.156	0.726
NAMS-UNC	-0.826	0.515	0.585
NAMS-UNC x ECF	-0.002	0.043	0.966
Indirect Effect			
Low NAMS-UNC	0.000	0.001	0.677
Med NAMS-UNC	0.000	0.001	0.661
High NAMS-UNC	0.000	0.001	0.668

Table 14

Model Results for Moderated Mediation via PBS-Limiting/Stopping Drinking (LSD), by NAMS-Uncontrollability (UNC)

Variables	RR/b	SE	*p*-value
Consequences on			
ECF	0.977	0.028	0.028
PBS-LSD	1.028	0.001	0.001
PBS-LSD on			
ECF	0.069	0.158	0.661
NAMS-UNC	-1.005	1.541	0.514
NAMS-UNC x ECF	-0.024	0.044	0.576
Indirect Effect			
Low NAMS-UNC	0.000	0.002	0.876
Med NAMS-UNC	0.000	0.001	0.849
High NAMS-UNC	0.001	0.002	0.628

Table 15

Model Results for Moderated Mediation via PBS-Manner of Drinking (MoD), by NAMS-Uncontrollability (UNC)

Variables	RR/b	SE	*p*-value
Consequences on			
ECF	0.934	0.013	0.000
PBS-MoD	1.023	0.008	0.003
PBS-MoD on			
ECF	0.098	0.116	0.400
NAMS-UNC	-0.692	1.131	0.541
NAMS-UNC x ECF	-0.035	0.032	0.274
Indirect Effect			
Low NAMS-UNC	-0.001	0.004	0.784
Med NAMS-UNC	0.001	0.003	0.680
High NAMS-UNC	0.003	0.003	0.324

Table 16

Model Results for Moderated Mediation via PBS-Serious Harm Reduction (SHR), by NAMS-Cognitive Harm (HARM)

Variables	RR/b	SE	*p*-value
Consequences on			
ECF	1.006	0.013	0.631
PBS-SHR	1.030	0.008	0.000
PBS-SHR on			
ECF	-0.022	0.136	0.871
NAMS- HARM	-0.224	0.637	0.726
NAMS- HARM x ECF	-0.009	0.024	0.708
Indirect Effect			
Low NAMS-HARM	0.000	0.001	0.697
Med NAMS-HARM	0.000	0.001	0.654
High NAMS-HARM	-0.001	0.001	0.656

Table 17

Model Results for Moderated Mediation via PBS-Limiting/Stopping Drinking (LSD), by NAMS-Cognitive Harm (HARM)

Variables	RR/b	SE	*p*-value
Consequences on			
ECF	0.977	0.011	0.028
PBS-LSD	1.028	0.008	0.001
PBS-LSD on			
ECF	-0.070	0.141	0.620
NAMS- HARM	0.398	0.660	0.546
NAMS- HARM x ECF	0.001	0.025	0.965
Indirect Effect			
Low NAMS-HARM	0.002	0.002	0.423
Med NAMS-HARM	0.001	0.001	0.310
High NAMS-HARM	0.001	0.002	0.446

Table 18

Model Results for Moderated Mediation via PBS-Manner of Drinking (MoD), by NAMS-Cognitive Harm (HARM)

Variables	RR/b	SE	*p*-value
Consequences on			
ECF	0.934	0.013	0.000
PBS-MoD	1.023	0.008	0.003
PBS-MoD on			
ECF	0.086	0.105	0.414
NAMS- HARM	0.908	0.493	0.065
NAMS- HARM x ECF	-0.030	0.019	0.114
Indirect Effect			
Low NAMS-HARM	0.000	0.004	0.949
Med NAMS-HARM	0.004	0.003	0.135
High NAMS-HARM	0.009	0.004	0.040

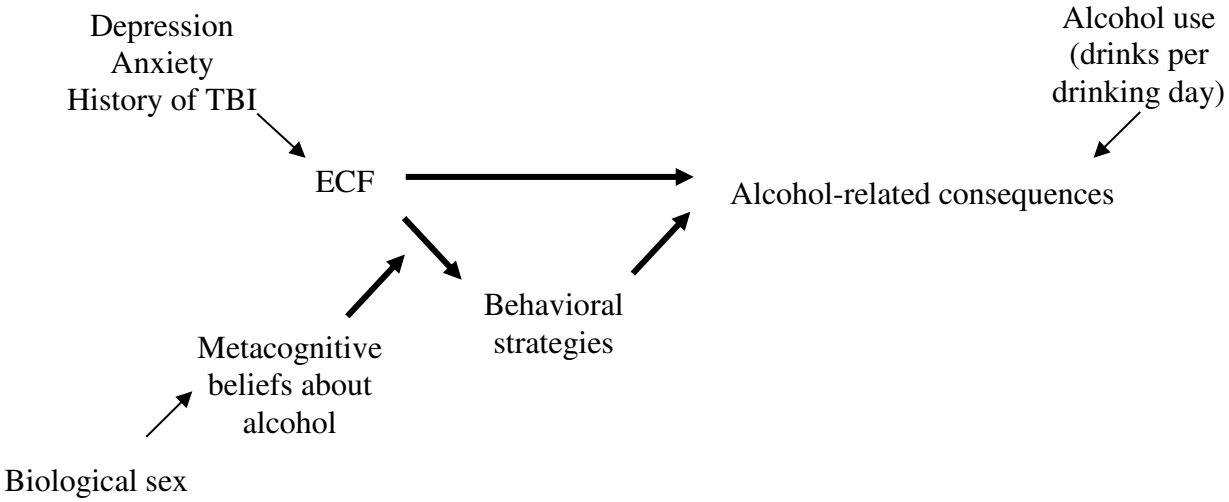

Figure 1. A representation of the primary analyses. It was hypothesized that the relation between ECF and consequences would be mediated by the use of behavioral strategies, and that metacognitive beliefs about alcohol would act as a moderator. Depression, anxiety, history of TBI, biological sex, and alcohol use were introduced into the model as covariates, signified by less-bold arrows.

STANDARD DRINK CONVERSION

When asked how much you drink in the following questions use this chart.

ONE STANDARD DRINK IS EQUAL TO:

Standard American BEER (3-5% alcohol) — 12 oz. Can, Bottle or Glass

Microbrew or European BEER (8%-12% alcohol) — 1/2 of a 12 oz. Can or Bottle

WINE (12 – 17% alcohol) — 4 oz. Glass

WINE Cooler — 10 oz. Bottle

HARD LIQUOR (80-proof, 40% alcohol) — 1-1/2 oz. or One Standard Shot

HARD LIQUOR (100-proof, 50% alcohol) — 1 oz.

WINE: 1 Bottle

25 oz. (12 – 17% alcohol) = 5 standard drinks
40 oz. (12 – 17% alcohol) = 8 standard drinks

HARD LIQUOR: 1 Bottle

12 oz. = 8 standard drinks
25 oz. = 17 standard drinks
40 oz. = 27 standard drinks

Figure 2. Standard drink reference sheet for participants' use during the TLFB.

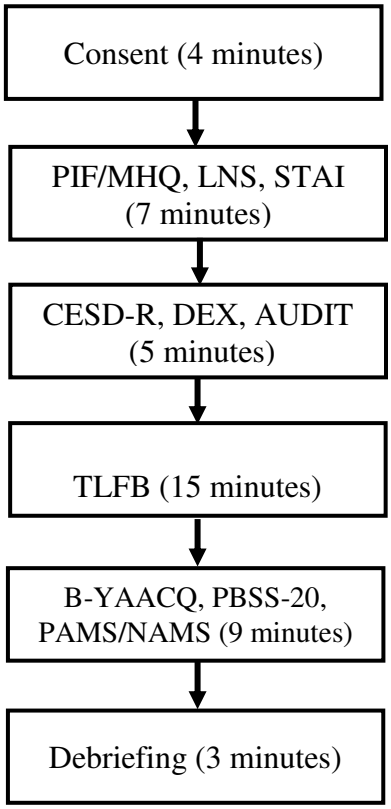

Figure 3. Study task order. Total session time was 45 minutes.

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APPENDIX A

Self-Report Measures

Personal Identification Form/Medical History Questionnaire (PIF/MHQ)

Section 1

1. What is your biological sex?
    a. Male
    b. Female
2. What is your height in inches?
3. What is your weight in pounds?
4. What is your race? Check all that apply.
    a. Native American or Alaska Native
    b. Asian
    c. Black or African American
    d. Native Hawaiian or Other Pacific Islander
    e. White
    f. Do not wish to respond
5. What is your ethnicity?
    a. Hispanic or Latino
    b. Not Hispanic or Latino
    c. Do not wish to respond
6. Are you right-handed?
    a. Yes
    b. No
7. What is your religious orientation?
    a. Christian
    b. Jewish
    c. Muslim
    d. Buddhist
    e. Hindu
    f. Non-religious
    g Atheist
    h. Agnostic
    i. Do not wish to respond
    j. Other
8. What is your marital status?
    a. Single
    b. Married
    c. Divorced
    d. Widowed
9. What is your academic year?
    a. Freshman
    b. Sophomore

c. Junior
d. Senior
e. Other

10. What is your current overall GPA? (Out of 4.0)

Section 2

11. Have you ever consumed alcohol?
    a. Yes [*Go to Section 3]*
    b. No [*Go to Section 4]*

Section 3

11a. How old were you the first time you consumed alcohol?

Section 4

12. Have you had any serious medical problems (heart conditions, HIV, diabetes, etc.)
    a. Yes
    b. No
13. Have you ever been hospitalized?
    a. Yes [*Go to Section 5]*
    b. No [*Go to Section 6]*

Section 5

13a. For what reason(s)?

[*Go to Section 6]*

Section 6

14. What medications are you taking now and for what conditions? (If not taking any medications, please type "none")
15. Have you ever had a seizure or been diagnosed with epilepsy?
    a. Yes
    b. No
16. Do you have vision or hearing problems (including color blindness)?
    a. Yes
    b. No
17. Have you ever received a psychological, neurological, or psychiatric diagnosis?
    a. Yes [*Go to Section 7]*
    b. No [*Go to Section 8]*

Section 7

17a.What was your diagnosis/diagnoses?

[*Go to Section 8]*

Section 8

18. Have you ever been hospitalized for a psychological, neurological or psychiatric problem?
    a. Yes [*Go to Section 9]*
    b. No [*Go to Section 10]*

Section 9

18a. Do you know what kind of medications you were given?

18b. Are you taking any of these now?

[*Go to Section 10]*

Section 10

19. Have you ever hit your head (e.g., fall, bike or motor accident, sports accident, or similar activity) or had your head hit with an object (e.g., bat, falling object, fight)?

a. Yes [*Go to Section 11]*
b. No [*Go to end of survey]*

Section 11

20a. Have you ever experienced the following symptoms as a result of hitting your head? Headache, confusion, lack of coordination, memory loss, nausea, vomiting, dizziness, ringing in the ears, sleepiness, fatigue [Checklist]

20b. How many times in your life have you experienced any of the above symptoms after hitting your head?

21. Have you ever experienced a loss of consciousness after hitting your head?

a. Yes [*Go to Section 12]*
b. No [*Go to end of survey]*

Section 12

21a. How do you know that you lost consciousness? (For example, was someone else there with you? Did someone else tell you?)

End of survey

Center for Epidemiological Studies-Depression Scale Revised (CESD-R)

Below is a list of the ways you might have felt or behaved. Please indicate how often you have felt these ways during the last week.

Answer on a scale of 1-4, 1=Rarely or none of the time (less than one day), 2=Some or a little of the time (1-2 days), 3=Occasionally or a moderate amount of the time (3-4 days), 4=Most or all of the time (5-7 days)

1. I was bothered by things that usually don't bother me.
2. I did not feel like eating; my appetite was poor.
3. I felt that I could not shake off the blues even with help from my family or friends.
4. I felt I was just as good as other people.
5. I had trouble keeping my mind on what I was doing.
6. I felt depressed.
7. I felt that everything I did was an effort.
8. I felt hopeful about the future.
9. I thought my life had been a failure.
10. I felt fearful.

State-Trait Anxiety Questionnaire, Trait Subscale (STAI)

A number of statements which people have used to describe themselves are given below. Rate each statement and select the appropriate number to indicate how you generally feel. There is no right or wrong answers. Do not spend too much time on any one statement, but give the answer which seems to describe how you generally feel.

Answer on a scale from 1-4, 1=Not at all, 2=Somewhat, 3=Moderately, 4=Very Much

1. I feel pleasant
2. I feel nervous and relentless
3. I feel satisfied with myself
4. I wish I could be as happy as others seem to be
5. I feel like a failure
6. I feel rested
7. I am “calm, cool, and collected”

8. I feel that difficulties are piling up so that I cannot overcome them
9. I worry too much over something that does not matter
10. I am happy
11. I have disturbing thoughts
12. I lack self-confidence
13. I feel secure
14. I make decisions easily
15. I feel inadequate
16. I am content
17. Somewhat unimportant thoughts run through my head and bother me
18. I take disappointment so keenly that I can't put them out of my mind
19. I am a steady person
20. I get in a state of tension or turmoil as I think over my recent concerns and interests

Dysexecutive Functioning Questionnaire (DEX)

Answer on a scale from 1-5, with 1=Never, 2=Occasionally, 3=Sometimes, 4=Fairly Often, 5=Very Often

1. I have problems understanding what other people mean unless they keep things simple and straightforward.
2. I act without thinking, doing the first thing that comes to mind.
3. I sometimes talk about events or details that never actually happened, but I believe did happen.
4. I have difficulty thinking ahead or planning for the future.
5. I sometimes get over-excited about things and can be a bit 'over the top' at times.
6. I get events mixed up with each other, and get confused about the correct order of events.
7. I have difficulty realizing the extent of my problems and am unrealistic about the future.
8. I am lethargic, or unenthusiastic about things.
9. I do or say embarrassing things when in the company of others.
10. I really want to do something one minute, but couldn't care less about it the next.
11. I have difficulty showing emotion.
12. I lose my temper at the slightest thing.
13. I am unconcerned about how I should behave in certain situations.
14. I find it hard to stop repeating, saying or doing things once they've started.
15. I tend to be very restless and 'can't sit still' for any length of time.
16. I find it difficult to stop myself from doing something even if I know I shouldn't.
17. I will say one thing, but will do something different.
18. I find it difficult to keep my mind on something, and am easily distracted.
19. I have trouble making decisions, or deciding what I want to do.
20. I am unaware of, or unconcerned about, how others feel about my behavior.

Alcohol Use Disorders Identification Test (AUDIT)

Choose the response that best describes your answer to each question.

1. How often do you have a drink containing alcohol?
    a. Never
    b. Monthly or less
    c. 2-4 times a month
    d. 2-3 times a week

    e. 4 or more times a week
2. How many drinks containing alcohol do you have on a typical day when you are drinking?
    a. 1 or 2
    b. 3 or 4
    c. 5 or 6
    d. 7 to 9
    e. 10 or more
3. How often do you have six or more drinks on one occasion?
    a. Never
    b. Less than monthly
    c. Monthly
    d. Weekly
    e. Daily or almost daily
4. How often during the last year have you found that you were not able to stop drinking once you started?
    a. Never
    b. Less than monthly
    c. Monthly
    d. Weekly
    e. Daily or almost daily
5. How often during the last year have you failed to do what was normally expected of you because of drinking?
    a. Never
    b. Less than monthly
    c. Monthly
    d. Weekly
    e. Daily or almost daily
6. How often during the last year have you needed a first drink in the morning to get yourself going after a heavy drinking session?
    a. Never
    b. Less than monthly
    c. Monthly
    d. Weekly
    e. Daily or almost daily
7. How often during the last year have you had a feeling of guilt or remorse after drinking?
    a. Never
    b. Less than monthly
    c. Monthly
    d. Weekly
    e. Daily or almost daily
8. How often during the last year have you been unable to remember what happened the night before because of your drinking?
    a. Never
    b. Less than monthly
    c. Monthly

    d. Weekly
    e. Daily or almost daily
9. Have you or someone else been injured because of your drinking?
    a. No
    b. Yes, but not in the last year
    c. Yes, during the last year
10. Has a relative, friend, doctor, or other health care worker been concerned about your drinking or suggested you cut down?
    a. No
    b. Yes, but not in the last year
    c. Yes, during the last year

Positive and Negative Metacognitive Beliefs about Alcohol Scale (PAMS/NAMS)
Answer on a scale of 1-4, 1=do not agree, 2=agree slightly, 3=agree moderately, 4= agree very much

1. Drinking makes me more affectionate.
2. Drinking makes me more confident.
3. Drinking makes me feel more relaxed.
4. Drinking reduces my anxious feelings.
5. Drinking makes me more sociable.
6. Drinking reduces my self-consciousness.
7. Drinking makes me feel happy.
8. Drinking helps me fit in socially.
9. Drinking makes me think more clearly.
10. Drinking helps me to control my thoughts.
11. Drinking makes my negative thoughts more bearable.
12. Drinking helps me focus my mind.
13. I have no control over my drinking.
14. My drinking persists no matter how I try to control it.
15. Drinking controls my life.
16. If I cannot control my drinking I will cease to exist.
17. Drinking will damage my mind.
18. Drinking will make me lose control.

Protective Behavioral Strategies Scale-Revised (PBSS-20)
For the following set of items, think about your behavior in the past 30 days. How often do you use the following behaviors when using alcohol or 'partying'?
Answer on a scale of 1-6, 1=Never, 2=Rarely, 3=Occasionally, 4=Sometimes, 5=Usually, 6=Always Controlling, except where otherwise indicated.

1. Determine not to exceed a set number of drinks.
2. Alternate alcoholic and nonalcoholic drinks.
3. Have a friend let you know when you've had enough.
4. Leave the bar/party at a predetermined time.
5. Stop drinking at a predetermined time.
6. Drink water while drinking alcohol.
7. Put extra ice in your drink.

8. Avoid drinking games.
9. Avoid mixing different types of alcohol.
10. Drink slowly, rather than gulp or chug
11. Avoid trying to "keep up" or out-drink others
12. Avoid "pre-gaming" (i.e., drinking before going out)
13. Use a designated driver
14. Make sure that you go home with a friend
15. Know where your drink has been at all times
16. Refuse to ride in a car with someone who has been drinking
17. Only go out with people you know and trust
18. Avoid combining alcohol with marijuana
19. Make sure you drink with people who can take care of you if you drink too much
20. Eat before or during drinking

Brief Young Adult Alcohol Consequences Questionnaire (B-YAACQ)

Below is a list of things that sometimes happen to people either during, or after they have been drinking alcohol. Next to each item below, please choose either YES or NO to indicate whether that item describes something that has happened to you IN THE PAST MONTH.

In the past month...
Answer yes or no

1. While drinking, I have said or done embarrassing things.
2. I have had a hangover (headache, sick stomach) the morning after I had been drinking.
3. I have felt very sick to my stomach or thrown up after drinking.
4. I often have ended up drinking on nights when I had planned not to drink.
5. I have taken foolish risks when I have been drinking.
6. I have passed out from drinking.
7. I have found that I needed larger amounts of alcohol to feel any effect, or that I could no longer get high or drunk on the amount that used to get me high or drunk.
8. When drinking, I have done impulsive things that I regretted later.
9. I've not been able to remember large stretches of time while drinking heavily.
10. I have driven a car when I knew I had too much to drink to drive safely.
11. I have not gone to work or missed classes at school because of drinking, a hangover, or illness caused by drinking.
12. My drinking has gotten me into sexual situations I later regretted.
13. I have often found it difficult to limit how much I drink.
14. I have become very rude, obnoxious or insulting after drinking.
15. I have woken up in an unexpected place after heavy drinking.
16. I have felt badly about myself because of my drinking.
17. I have had less energy or felt tired because of my drinking.
18. The quality of my work or schoolwork has suffered because of my drinking.
19. I have spent too much time drinking.
20. I have neglected my obligations to family, work, or school because of drinking.
21. My drinking has created problems between myself and my boyfriend/girlfriend/spouse, parents, or other near relatives.
22. I have been overweight because of drinking.

23. My physical appearance has been harmed by my drinking.
24. I have felt like I needed a drink after I'd gotten up (that is, before breakfast).