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BEHAVIORAL ECONOMIC MODERATORS OF THE ASSOCIATION BETWEEN
INTENTION AND CHANGES IN DRINKING

by

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A Thesis

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Abstract

Intention to change predicts change in drinking following an intervention, but many people who intend to change do not follow through and little research has examined factors that might account for this intention-change disconnect. Behavioral economic research suggests elevated alcohol demand, deficits in environmental reward, and steep discounting of delayed rewards are associated with stable heavy drinking, and the current study tests the hypothesis that these individual difference risk variables moderate the relationship between intention and change in drinking. Greater post-session intent to change predicted greater reductions in drinking and related problems. Environmental suppression and alcohol demand emerged as significant moderators of the association between intention and typical weekly drinking at follow-up. Individuals with low intent to change, combined with elevated demand or low substance-free reward, are least likely to reduce their drinking; however, elevated behavioral economic risk did not reduce the predictive utility of post-session intentions on drinking reductions.

TABLE OF CONTENTS

Chapter	Page
1. Introduction	1
Brief Motivational Interventions	1
Intention to Change as a Predictor of Treatment Outcomes	2
Behavioral Economics Variables as Potential Moderators of the Association between Intention to Change and Subsequent Change in Drinking	3
2. Research Question and Hypothesis	6
3. Method	6
Participants	7
Measures	7
Intention to Change Drinking Behavior	7
Importance of Immediate Versus Distal Behavioral Outcomes	8
Alcohol Demand	8
Response Contingent Barriers to Positive Reinforcement	9
Alcohol-Related Consequences	9
Typical Week Alcohol Consumption	10
4. Procedure	10
5. Data Analytic Plan	10
6. Results	12
Behavioral Economic Variables and Treatment Condition as Moderators of the Association between Intention and Change in Typical Weekly Drinking	13
Response Contingent Barriers to Positive Reinforcement	13
Consideration of Future Consequences	14
Alcohol Demand	14
Treatment Condition	15
Behavioral Economic Variables as Moderators of the Association between Intention and Change in Alcohol Related Consequences	15
7. Discussion	16
Clinical Implications	18
Strengths, Limitations, and Future Directions	19
8. Conclusion	20
References	21
Appendix	31

Introduction

College students are a high-risk population for heavy episodic drinking (4/5 drinks for women/men) and a variety of alcohol-related health and social consequences (SAMHSA, 2015; Hingson et al., 2017). Vulnerabilities are related to their typical developmental stage (i.e., emerging adulthood), and include reduced ability to consider future consequences of behavior, belief in exaggerated drinking norms, and widespread availability of alcohol in highly reinforcing social contexts, all of which increase risk for heavy drinking (Johnson et al., 2009; Murphy & Dennhardt, 2016). Heavy drinking may result in negative health and social consequences that include disrupted sleep, eating, and interpersonal relationships, as well as risky sexual behavior, memory loss, and developing an alcohol use disorder (Merrill & Carey, 2016). Interventions aimed at reducing heavy drinking and associated consequences have been developed to address this important public health problem, but there is a need to continue researching the psychological processes that facilitate drinking reductions (i.e., mechanisms of behavioral change) in order to improve these treatments (Magill et al., 2017; Mechanisms of Behavior Change Satellite Committee, 2018).

Brief Motivational Interventions

Most college student drinkers have relatively low motivation to change their drinking behavior, and thus require an intervention that enhances desire to change (Gaume et al. 2013; Vader et al. 2010). Brief motivational interventions (BMIs) are typically 1-2 sessions in length and combine motivational interviewing (Miller & Rollnick, 2012) and personalized feedback to encourage the student to evaluate the pros and cons of their drinking, and, if they are interested, to generate a clear plan reduce use or related harm. These interventions have been associated with significant reductions in weekly drinking, heavy episodic drinking, and alcohol-related

problems at follow-up ranging from 1-12 months (Carey et al. 2006, 2007; Crouce & Larimer, 2011; Tanner-Smith & Lipsey, 2015; Magill et al., 2017). A meta-analysis by Huh and colleagues (2015) indicated that overall effect sizes associated with BMI were small, as might be expected given their brevity and the fact that study participants are typically not seeking treatment. In order to ultimately increase the efficacy of BMIs, there is a need to better understand predictors and processes associated with successful reductions in drinking and associated consequences.

Intention to Change as a Predictor of Treatment Outcomes

The Theory of Planned Behavior (TPB; Ajzen, 1991) proposes that “intentions are assumed to capture the motivational factors that influence a behavior” (p. 181). A desire to change may be a necessary precursor to behavioral change and is a key intervention target for BMIs. BMIs attempt to influence intention to change behavior by increasing normative and self-ideal discrepancy, thereby increasing the perceived dissonance between an individual’s personal drinking pattern and an external (drinking of others) or internal (personal goals/values) standard (Miller & Rollnick, 2012). Furthermore, the TPB posits that intention is comprised of attitude towards a behavior, subjective norms, and perceived behavioral control. One study found support for intention (e.g., intending on engaging in behaviors consist with heavy episodic drinking, intending to reduce drinking) and self-efficacy (e.g., confidence or certainty of engaging in heavy episodic drinking behavior) as prospective predictors of heavy episodic drinking in a sample of undergraduate students (Norman & Conner, 2006).

In a meta-analysis examining the relation of changes in behavioral intention leading to behavioral change, Webb and Sheeran (2006) found that medium-to-large changes in intention resulted in small-to-medium changes in behavior. Intention to change (i.e., a specific plan to

change a behavior) and the related construct of motivation to change (i.e., general reasons and recognition of a need to change behavior) are highly correlated to the point of near redundancy ($r = .82$; Rhodes et al., 2006). Murphy and colleagues (2010) found that increases from pre- to post-session motivation were partially associated (i.e., small-medium effect size) with lower levels of alcohol consumption at follow-up. Borsari and colleagues (2009) found in three studies using BMIs in college student drinkers, post-session motivation tended to increase but did not appear to be a mechanism of behavior change; also, suggesting further research on social-contextual variables that may account for drinking reductions. Given the complex nature of the intention-behavior relationship, and the potential clinical utility of accurately measuring likelihood of change following an intervention (e.g., to guide stepped care approaches; Borsari et al., 2012), further research is warranted to expand upon existing models by identifying factors that influence the association between intention and subsequent change in drinking behavior. Specifically, as described next, behavioral economic variables that summarize the strength of alcohol as a reinforcer (demand), future time orientation, and environmental reward may impact the extent to which individuals who express an intention to change are able to successfully follow through with that plan (Murphy et al., 2006; 2015).

Behavioral Economics Variables as Potential Moderators of the Association between Intention to Change and Subsequent Change in Drinking

Behavioral economics integrates principles of behavioral psychology with economic theory to better understand decision-making processes that underlie patterns of behavior, including decisions to use alcohol or other drugs versus engaging in other behaviors (Bickel et al., 1995). Behavioral economic research indicates that substance use is most likely when the price (e.g., monetary value) of substance is low, there are minimal constraints on access to

substance use, and there is low availability of substance-free alternative sources of reward in the environment.

Several behavioral economic constructs (e.g., delay discounting and consideration of future consequences) have support as predictors of treatment outcomes and may also be related to the strength of the association between intention to change alcohol use and actual drinking change. Delay discounting (DD) reflects the degree to which rewards are devalued as a function of the delay to the receipt of the reward. Alcohol and other drug use are associated with relatively small immediate reward (e.g., acute intoxication, euphoria, relaxation) whereas many drug-free alternatives require effort over time to yield subjectively larger but delayed economic, social, and health-related rewards. Steep discounting of delayed rewards (i.e., stronger preference for immediate reinforcers over delayed reinforcers) is an individual difference variable that is highly related to alcohol and drug misuse (Amlung et al., 2017; Bickel & Marsch, 2001). Consideration of future consequences (CFC) is a related construct, reflecting a general tendency to consider the future in making decisions (i.e., immediate versus distal behavioral outcomes are weighed) (Strathman et al., 1994). CFC uses face valid items (e.g., I only act to satisfy immediate concerns, figuring out the future will take care of itself), while DD uses hypothetical monetary choices (e.g., If given the option, would you rather have \$20 today or \$100 in 1 day?). Behavioral economic constructs of trait-based DD and CFC have been used to measure substance use outcomes associated with changes in substance use (Black & Rosen, 2011; Daugherty & Brase, 2010; Johnson et al., 2010; Loree et al., 2015; Strickland et al., 2017). However, research is mixed in that DD has been shown to predict changes in smoking but has not been found to be predictive of change in drinking following brief alcohol interventions (Dennhardt et al., 2015; MacKillop & Kahler, 2009; Murphy et al., 2012, 2015, 2019). CFC has

shown some evidence of association with brief intervention response in college student drinkers (Murphy et al., 2012). Individuals who are present focused (i.e., steep discounters) may be less likely to follow-through with intentions to change problematic substance use when drinking is immediately available, as it may undermine their resolve.

Alcohol demand, another behavioral economic construct, refers to motivation to drink alcohol at escalating costs (Hursh et al., 2005), is associated with AUD's (MacKillop et al., 2010) and is predictive of problematic alcohol consumption in college students (Lemley et al., 2016; MacKillop & Murphy, 2007; Murphy et al., 2015). Hypothetical alcohol purchase tasks are used to generate demand curves from which these indices of alcohol demand (e.g., maximum level of alcohol consumption at low cost and maximum level of alcohol expenditure) can be derived. Greater alcohol demand (i.e., larger relative reinforcing value of alcohol) at baseline is predictive of greater weekly drinking and heavy drinking in college students (MacKillop & Murphy, 2007). Cassidy and colleagues (2019) found that a BMI was especially efficacious for young adult heavy drinkers with elevated demand for alcohol at baseline. Individuals that have high demand are likely to have more difficulties with heavy drinking but also benefit from BMIs.

Another factor to consider is the availability of alternative, substance-free reinforcers (e.g., peers, recreation, or work) in that the access of alternative substance-free reinforcement is protective against alcohol problems (Joyner et al., 2018; Murphy et al., 2007; Skidmore & Murphy, 2010). Environmental suppression of response-contingent positive reinforcement (i.e., external factors that prevent access to non-substance related rewards) is predictive of alcohol related consequence (Joyner et al., 2016). Generally, there is an inverse association between substance-free reinforcement and substance use in college students, such that deprivation or absence of substance-free reinforcers is linked to increases in heavy episodic drinking (Acuff et

al., 2019; Correia et al., 2003; Murphy et al., 2005, 2015, 2019). Substance free activity session supplements following BMI's have been associated with decreases in heavy drinking for college students that reported lower levels of substance free reinforcement (Murphy et al., 2012, 2019). Individuals with barriers limiting access to substance-free rewards may have greater difficulties changing behaviors related to substance use due to the increased availability of substance related rewards relative to alternatives.

Research Question and Hypothesis

The current study investigates whether behavioral economic indices moderate the effect of intention to change drinking behavior following a BMI on actual drinking changes one-month later. Independently, behavior economic variables and intention to change drinking behavior have been shown to be good predictors of change in drinking; however, these they have yet to be studied within the same model. Furthermore, this study may provide a framework to better understand why intention to change drinking behavior does not fully account for why some individuals improve following treatment while others do not. It is hypothesized that: (1) post-session intent to change drinking behavior will predict change in drinking following a BMI at 1-month follow-up (2) the association between intention and behavior change will be smaller in individuals with elevated demand, low substance-free reward, and low consideration of future consequences. Thus, individuals with these behavioral economic risk factors may be less likely to successfully follow through with behavior change intentions established in the brief intervention sessions and may require more intensive interventions to bridge the intention-behavior change gap.

Method

Participants

The current study is a secondary analysis of a published clinical trial (see Murphy et al., 2019 for full study details; ClinicalTrials.gov NCT number 02834949). A total of 393 participants were recruited through classes and e-mail solicitations from the University of Memphis and the University of Missouri for a BMI study and were randomized to either a control condition (N = 138), a BMI plus relaxation training (N = 125), or a BMI plus a substance-free activity session (N = 130) (see Murphy et al., 2019 for full study details). All participants endorsed recent heavy episodic drinking (four/five or more drinks on one occasion for women/men). Participants were given assessment questionnaires at baseline; however, post session intention to change drinking behavior was not assessed for the control condition as they did not receive an intervention. For the purposes of this study, participants randomized to the two intervention conditions were included in the analyses as the current research questions are interested in studying the effects of behavioral economic moderators of the association of intention and changes in drinking behavior following a brief motivational intervention. Participants were 63.1% female and 49% of this sample was randomized to BMI plus relaxation intervention with 51% in the BMI plus substance free activity session condition. Additionally, 54% of the participants were recruited from the University of Memphis and 46% from the University of Missouri. The demographic composition of the sample was 83.9% Caucasian, 12.2% Black, and 6.7% Hispanic.

Measures

Intention to Change Drinking Behavior

A single, post-session item was used to assess intention to change drinking behavior following the second brief intervention session (substance-free activity session or relaxation

training). The question was: “Indicate how likely you are to change your drinking in the near future.” This question was answered on a 10-point scale where 1 is indicative of “*I will definitely not change my drinking*” 5-6 is “*unsure,*” and 10 “*I will definitely change my drinking.*” Single measure items of intention have demonstrated face validity and concordance with multi-item measures of intention (Kavanaugh & Schwarz, 2009).

Importance of Immediate Versus Distal Behavioral Outcomes

The Consideration of Future Consequences Scale - Short Version (CFC-SV; Strathman et al., 1994) is a 9-item self-report measure of immediate versus longer-term outcomes (e.g., “Often I engage in a particular behavior in order to achieve outcomes that may not result for many years” and “I only act to satisfy immediate concerns, figuring the future will take care of itself”). Each question is rated on a 5-point Likert-type scale ranging from 1 (*extremely uncharacteristic*) to 5 (*extremely characteristic*). The CFC score is calculated summing the individual items to form a composite score, which has been shown to have good convergent, construct, and test-retest validity (Adams & Nettler, 2009; Strathman et al., 1994). In the current sample, the internal consistency of the CFC-SV was $\alpha = .80$.

Alcohol Demand

The Alcohol Purchase Task (APT; Murphy & MacKillop, 2006; Murphy et al., 2009) is a self-report measure that asks participants how many drinks they would purchase at various prices (starting low and steadily increasing) in a hypothetical scenario. Data points are plotted, and the resulting demand curve allows for the calculation of various measures of alcohol demand (e.g., intensity and O_{\max}). Data were cleaned using the Stein macro (Stein et al., 2015) and were based on the following criteria: trend (detection limit for $Q < 0.025$); bounce (detection limit for $B = 0.10$); and reversal from zero (detection limit number for reversals = 2 or more). Participants

who violated these criteria were not included in subsequent analyses. Intensity and O_{\max} were selected as demand indices because they are expected to be sensitive to BMIs and are consistently associated to alcohol-related outcomes (Kiselica & Borders, 2013; Murphy et al., 2015; Skidmore et al., 2014). Intensity is defined as consumption of alcohol when drinks are free and O_{\max} is maximum alcohol expenditure. The APT has demonstrated good test-retest reliability (Murphy et al., 2009) as well as strong associations with actual lab-based drink purchases (Amlung et al., 2012).

Response Contingent Barriers to Positive Reinforcement

The Reward Probability Index (RPI; Carvalho et al., 2011) is a 20-item measure that is designed to assess access to reward and experience of reward. The RPI– Environmental Suppressor Scale (RPI-ESS) is comprised of a subset of items that measure obstacles that may impede the ability to engage in rewarding experiences (e.g., “I have few financial resources, which limits what I can do” and “I wish I could find a place to live that brought more satisfaction to my life”) and has demonstrated strong internal consistency (Carvalho et al., 2011; Joyner et al. 2016). Individual items are scored on a 1 (*strongly disagree*) to 4 (*strongly agree*) Likert-type scale, with higher RPI-ESS scores indicative of more barriers that impede access to positive rewards (i.e., lower reward). The internal consistency of the RPI-ESS was $\alpha = .85$ in this sample.

Alcohol-Related Consequences

The Young Adult Alcohol Consequences Questionnaire (YAACQ; Read et al., 2006) was used to measure problems associated with alcohol. The YAACQ asks participants if they experienced specific alcohol related problems (e.g., “I have taken foolish risks when I have been drinking” and “I haven’t been as sharp mentally because of my drinking”) at least once in the past month and has demonstrated strong internal consistency, test-retest reliability, and

concurrent and predictive validity (Read et al., 2007). The Cronbach's alpha for the YAACQ was $\alpha = .90$ for the current sample.

Typical Week Alcohol Consumption

The Daily Drinking Questionnaire (DDQ; Collins et al., 1985) is a retrospective estimate of the typical number of alcoholic beverages consumed each day in a typical week, within the past month. Typical weekly drinking was calculated by adding the number of standard drinks reported for each day. The DDQ has been used extensively with college student drinkers and is highly correlated with self-monitored drinking reports (Kivlahan et al., 1990).

Procedure

An Institutional Review Boards approved all procedures. Following the informed consent and baseline assessment, participants were randomized to either assessment-only, BMI plus relaxation training (RT), or BMI plus substance-free activity session conditions (SFAS). Participants assigned to intervention conditions completed a 50-minute BMI session and one week later completed either a 50-minute RT or SFAS session with the same clinician. Follow-up assessments occurred at 1, 6, 12, and 16-month time points, to allow follow-ups to occur at same time-points in the semester as initial baseline assessments, and to account for influences that may be due to the academic calendar. Furthermore, all time points were selected to exclude winter and summer break, when alcohol use may be atypical. The 1-month follow-up was selected as the main focus of this study because it was the most proximal time point following the intervention and most BMI studies suggest that change generally occurs shortly after a BMI and is generally stable thereafter (Walters & Neighbors, 2005). These findings were reflected in this trial. For further description of study procedures refer to Murphy and colleagues (2019).

Data Analytic Plan

Data screening was handled according to guidelines from Tabachnick and Fidell (2012), paying attention to univariate and multivariate outliers, evaluation of the amount of missing data, assessment of heteroscedasticity, as well as skew and kurtosis. Six univariate outlier cases were identified for the intensity variable and 4 for the O_{\max} variable as defined by being greater than 3.29 standard z-scores. Each univariate outlier was winsorized to reduce the effect of outliers and minimize the amount of missing data. Three participants were eliminated from the demand curve analyses based on the Stein criteria. Baseline and 1-month follow-up typical weekly drinking and alcohol related consequences variables were transformed using a square root transformation to address high kurtosis and positively skewed distributions. Correlations between all variables were conducted and inspected for issues of multicollinearity and singularity. Hayes' Process Macro version 3.4 (Hayes, 2016) for SPSS was used to run moderation analyses and probe significant interactions via simple slopes. Analyses consisted of the post-intervention intention to change predicting changes in drinking (i.e., DDQ or YAACQ) at 1-month follow-up with behavioral economic indices (i.e., intensity, O_{\max} , environmental suppressors, and CFC) and treatment condition as individual moderators in each analysis. Additionally, analyses controlled for yearly and disposable income, race, site, gender, treatment condition, baseline alcohol problems and weekly drinking given the potential association between these variables and 1-month weekly drinking and alcohol problems. After mean centering intention and moderator variables, analyses consisted of a nonparametric bootstrapping method of 5000 samples set at 95% confidence intervals. Hayes' Process Macro provided Johnson-Neyman output for significant interactions and were used to visualize the conditional effects of the focal predictor (changes in drinking or alcohol related consequences at 1 month follow-up while controlling for baseline levels). Graphs were generated using the Johnson-Neyman output in SPSS, plotting

level of intention and the focal predictor on the x and y axis respectively. The moderator values in the conditional tables used to plot the graphs are in the 16th, 50th, and 84th percentiles and were labeled as low, moderate, and high levels.

Results

Participants drank an average of 16.3 ($SD = 11.7$) drinks in a typical week and endorsed an average of 13 ($SD = 7.7$) alcohol related problems in the past month. Descriptive statistics and bivariate correlations among study variables at baseline are presented in Table 1. As expected, typical weekly alcohol consumption was significantly positively correlated with alcohol related problems, intensity, and O_{max} . However, typical weekly alcohol consumption was not significantly correlated with intention to change, environmental suppression, or consideration of future consequences. Alcohol related problems were significantly positively correlated with intention and intensity, as well as negatively correlated with consideration of future consequences. However, alcohol related problems were not significantly correlated with environmental suppression or O_{max} . O_{max} was significantly positively correlated with intensity, but was not correlated with intention, environmental suppression, or consideration of future consequences. Similar to O_{max} , intensity was not correlated with intention, environmental suppression, or consideration of future consequences. Environmental suppression did not significantly correlate with any other variables. Lastly, consideration of future consequences was significantly correlated with alcohol-related consequences but not with other variables.

There was a significant between-conditions difference in typical weekly drinking at baseline ($F(2, 202) = 11.32, p = 0.005$). Participants randomized to BMI+RT reported significantly less drinking ($M = 13.80, SE = 0.90$) compared to those randomized to the BMI+SFAS condition ($M = 19.67, SE = 1.88$), consistent with the published clinical trial. There

were no significant treatment group differences on baseline demographics, post-session intention to change drinking behavior, behavioral economic variables of interest (environmental suppression, consideration of future consequences, intensity, and O_{max}), and baseline alcohol related consequences.

Behavioral Economic Variables and Treatment Condition as Moderators of the Association between Intention and Change in Typical Weekly Drinking

Response Contingent Barriers to Positive Reinforcement

In the first model, post-session intention to change drinking behavior was evaluated as a predictor of typical weekly drinking at 1-month follow-up, and baseline environmental suppression scores were evaluated as a moderator (see Table 2). Site, condition, gender, and typical weekly drinking at baseline variables were included as covariates. Disposable income, yearly income, and race were included in initial analyses as covariates; however, these variables did not significantly improve the overall model and were subsequently excluded from the following analyses. Intention and baseline typical weekly drinking, but not response contingent barriers to positive reinforcement, accounted for significant variance in predicting typical weekly alcohol consumption at 1-month follow-up. However, the interaction of intention and RPI-ESS accounted for significant variance in predicting typical weekly alcohol consumption at 1-month follow-up. An examination of the interaction plot (see Figure 1) showed that although overall greater intention was associated with lower levels of follow-up drinking, this effect was only significant at low and moderate levels of environmental suppression (i.e., high and moderate levels of reward).

Consideration of Future Consequences

In the second model, post-session intention to change drinking behavior was evaluated as a predictor of typical weekly drinking at 1-month follow-up, and baseline consideration of future consequences scores were evaluated as a moderator. Site, condition, gender, and typical weekly drinking at baseline variables were included as covariates. Intention and baseline typical weekly drinking, but not consideration of future consequences, accounted for significant variance in predicting typical weekly alcohol consumption at 1-month follow-up. There was a non-significant, trend level effect of greater CFC predicting lower drinking at follow-up. The interaction between intention and CFC was not significant.

Alcohol Demand

In the third model, post-session intention to change drinking behavior was evaluated as a predictor of typical weekly drinking at 1-month follow-up, and baseline intensity scores were evaluated as a moderator with identical covariates. Intention, intensity, and baseline typical weekly drinking accounted for significant variance in predicting typical weekly alcohol consumption at 1-month follow-up. The interaction of intention and intensity accounted for significant variance in predicting typical weekly alcohol consumption at 1-month follow-up. An examination of the interaction plot (see Figure 2) showed that although overall greater intention was associated with lower levels of follow-up drinking, this effect was only significant at moderate and high levels of intensity (i.e., moderate and high consumption of alcohol when drinks are free).

In the fourth model, post-session intention to change drinking behavior was evaluated as a predictor of typical weekly drinking at 1-month follow-up, and baseline O_{\max} scores were evaluated as a moderator with identical covariates. Intention and baseline typical weekly

drinking, but not O_{\max} , accounted for significant variance in predicting typical weekly alcohol consumption at 1-month follow-up. The interaction of intention and O_{\max} accounted for significant variance in predicting typical weekly alcohol consumption at 1-month follow-up. An examination of the interaction plot (see Figure 3) showed that greater intention was associated with lower levels of follow-up drinking and this effect was significant at low, moderate, and high levels of O_{\max} (i.e., all levels of maximum alcohol expenditure).

Treatment Condition

In the fifth model (see Table 2), post-session intention to change drinking behavior was evaluated as a predictor of typical weekly drinking at 1-month follow-up, and treatment condition (i.e., BMI plus relaxation or substance free activity session) was evaluated as a moderator with identical covariates. Intention and baseline typical weekly drinking, but not treatment condition, accounted for significant variance in predicting typical weekly alcohol consumption at 1-month follow-up. The interaction between intention to change drinking behavior and treatment condition emerged as statistically significant; however, this may be in part due to significant between-conditions differences in typical weekly drinking at baseline.

Behavioral Economic Variables as Moderators of the Association between Intention and Change in Alcohol Related Consequences

Models 6-9 evaluated the RPI-ESS, CFC, intensity, and O_{\max} as moderators of the association between intention to change drinking and alcohol-related consequences at one-month follow-up. Results are presented in Table 3. Of note, consideration of future consequences and intensity were significant predictors of alcohol related consequences, but environmental suppression and O_{\max} were not. Overall, none of the models produced a significant interaction

between intention and the four behavioral economic variables and thus, no interactions were probed.

Discussion

The purpose of this study was to investigate behavioral economic indices as potential moderators of the effect of intention to change drinking behavior on drinking outcomes following a BMI. Overall, intention to change predicted subsequent change in drinking and related problems. Environmental suppression, intensity, and O_{\max} emerged as significant moderators of the relation of intention to change drinking behavior and typical weekly alcohol consumption at one-month follow-up. None of the variables examined were significant moderators of the association between intention and change in alcohol-related problems.

The present study provides support for intention to change drinking behavior following a BMI as a predictor of drinking outcomes and the utility of studying behavioral economic indices as moderators. Consistent with the literature, results support a small, direct association between intention to change drinking behavior at follow-up and subsequent self-reported change in drinking behavior one month later (Murphy et al., 2010; Webb & Sheeran, 2006). Following a BMI, participants with higher post-session intent to change drinking behavior tended to drink less compared to their lower intentioned counterparts. These findings are consistent with the Theory of Planned Behavior literature, in that intention is a good predictor of drinking behavior in heavy drinking college students (Collins et al., 2001; Elliott & Ainsworth, 2012). These results also support the utility of BMIs which focus on increasing intention to change drinking behavior in a population that typically has low motivation to change and is not usually seeking treatment.

Participants' baseline environmental reward suppression interacted with post-session intention to change to predict change in drinking. Overall, intention to change was unrelated to

actual change in participants with high environmental suppression (i.e., low levels of reward). Contrary to hypotheses, participants with lower behavioral intention to change drinking patterns and low environmental suppression (i.e., high levels of reward) reported the highest drinking at follow-up. Higher environmental reward would be expected to be associated with less drinking; however, for college students drinking can be associated with rewards (e.g., social connections). Thus, it is possible that a college student who drinks heavily, has ample reward (i.e., substance free and substance related reward) in their environment, and low intention to change is unlikely to change their drinking behavior.

Participants' baseline level of alcohol demand interacted with post-session intention to change to predict change in drinking. Overall, intention to change was unrelated to actual change in participants with low intensity values. These individuals were fairly light drinkers at baseline and their intention to change was largely unrelated to their actual follow-up drinking (which remained low). Intention to change was associated with actual change in drinking across all levels of O_{max} . Thus, overall high demand did not reduce the association between intention to change and actual change. Consistent with hypotheses, participants with higher baseline intensity and O_{max} (i.e., higher valuation of alcohol) coupled with lower intention to change drinking behavior following a BMI drank more at follow-up. Conversely, higher post-session intention to change behavior was predictive of low alcohol consumption irrespective of alcohol valuation. Thus, higher post-session intention to change drinking behavior may serve as a useful predictive indicator of lower alcohol consumption, while higher valuation of alcohol paired with low intention to change behavior can help identify higher risk individuals. Consistent with the literature, higher valuation of alcohol was associated with higher levels of drinking (Amlung et al., 2017; Murphy et al., 2019; Teeters et al., 2014). Results suggest that baseline demand

predicts likelihood of change in drinking following treatment and is a useful moderator of the association between intention and subsequent changes in drinking.

Contrary to our hypotheses, no significant interactions emerged in analyses predicting alcohol related consequences. This could be due in part to the fact that the direct effect of intention on typical weekly drinking was about twice the size of the direct effect of intention on alcohol related consequences, despite the fact that the primary outcomes indicated significant reductions in alcohol problems at the one-month follow-up. Thus, alcohol related consequences were less influenced by the main effect of intentions and this likely reduced variability needed to detect interactions. This is not surprising given that the intention item asks directly about intention to change drinking versus intention to change alcohol problems. Future research should examine an intention item specifically focused on avoiding alcohol-related consequences.

Clinical Implications

The assessment of intention to change drinking behavior following a BMI was negatively associated and predictive of drinking behavior, with higher levels of intention indicative of lower overall alcohol consumption at follow-up. These effects were amplified depending on the level of alcohol demand and access to environmental rewards; however, intention is more predictive of change in higher risk participants based on elevated baseline demand but less predictive among those who are higher risk with respect to low environmental reward. Additionally, level of future orientation does not influence the extent to which intention translates into drinking reduction. Early identification of higher risk individuals immediately following a BMI coupled with additional support (e.g., pharmacological intervention, psychotherapy, or self-help programs) may help alter their trajectory and result in improved outcomes (Cohen et al., 2007; Epler et al., 2009; Pettinati et al., 2006). Furthermore, these findings support the use of behavioral economic

supplements (e.g., Substance Free Activity Sessions) to enhance the effects existing BMIs in reducing alcohol demand and increase engagement in substance free alternatives (Murphey et al., 2012, 2019).

Strengths, Limitations, and Future Directions

The current study was the first to look at the moderating effect of behavioral economic indices (i.e., demand, response contingent barriers to positive reinforcement, and consideration of future consequences) on the relationship between intention to change drinking behavior and drinking outcomes. Moreover, the study sought to better understand these factors as they relate to change in drinking and related problems in heavy drinking college students following a BMI. This study had the added benefit of using longitudinal data to investigate the research question at hand, which allowed for results to be attributed to changes following an intervention targeted at reducing problematic drinking behavior. However, limitations included conducting post-hoc analyses on an existing dataset and the inability to compare treatment conditions to a true control condition, as intention to change drinking behavior was not assessed for participants that did not receive any intervention.

Although the current findings may generalize to other university drinking populations, the results may not generalize to other populations including individuals with more severe AUD or those who are participating in formal alcohol treatment. Additionally, the use of a single item of intention to represent an entire construct, despite evidence of validity, may not encapsulate the multi-faceted nature of the construct (e.g., attitudes towards behavior and subjective norms). Future studies may benefit from using multi-dimensional measures of intention to change as the single, overall intention to change drinking item used may not be sensitive to more subtle harm reduction changes that were the focus of the intervention (e.g., spacing drinks, reducing peak

consumption levels, and avoiding drinking in higher risk situations). Furthermore, the incorporation of a control group would provide insight into whether the observed association between intention and behavior change, as moderated by behavioral economic variables, was specific to an intervention or attributable to a more general change process. These findings would be important as most emerging adults do not seek out interventions but make changes on their own (Cellucci et al., 2006; Epler et al., 2009; Komiya et al., 2000). Lastly, recruitment of participants from the community would improve upon and increase the generalizability of these findings.

Conclusion

Until now, the interplay of how behavior economic variables moderate the relationship between intention to change behavior predicting treatment outcomes had not been explored. This study demonstrated that intention to change behavior following a brief motivational intervention has a direct association with actual change in drinking behavior in which higher levels of intended behavioral change predicted a decrease in drinking. Although there are limitations, this study bridges these two areas of study (i.e., intention to change behavior and behavioral economics) and demonstrated that demand and environmental reward moderate this intention-behavior relationship in heavy drinking college students. However, the moderating effect of alcohol demand (i.e., intensity and O_{max}) and environmental suppression on intention to change drinking behavior existed when predicting typical weekly alcohol consumption, but not for alcohol-related consequences. Thus, further research is needed to better understand the significance and underlying reasons for when this effect is present or if alternative factors pertaining to alcohol-related consequences could be explored.

References

- Acuff, S. F., Dennhardt, A. A., Correia, C. J., & Murphy, J. G. (2019). Measurement of substance-free reinforcement in addiction: A systematic review. *Clinical Psychology Review, 70*, 79-90.
- Adams, J., & Nettle, D. (2009). Time perspective, personality and smoking, body mass, and physical activity: An empirical study. *British Journal of Health Psychology, 14*(1), 83-105.
- Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes, 50*(2), 179-211.
- Amlung, M. T., Acker, J., Stojek, M. K., Murphy, J. G., & MacKillop, J. (2012). Is talk “cheap”? An initial investigation of the equivalence of alcohol purchase task performance for hypothetical and actual rewards. *Alcoholism: Clinical and Experimental Research, 36*(4), 716-724.
- Amlung, M., MacKillop, J., Monti, P. M., & Miranda Jr, R. (2017). Elevated behavioral economic demand for alcohol in a community sample of heavy drinking smokers. *Journal of Studies on Alcohol and Drugs, 78*(4), 623-628.
- Amlung, M., Vedelago, L., Acker, J., Balodis, I., & MacKillop, J. (2017). Steep delay discounting and addictive behavior: A meta-analysis of continuous associations. *Addiction, 112*(1), 51-62.
- Bickel, W. K., Green, L., & Vuchinich, R. E. (1995). Behavioral economics. *Journal of the Experimental Analysis of Behavior, 64*(3), 257.
- Bickel, W. K., & Marsch, L. A. (2001). Toward a behavioral economic understanding of drug dependence: Delay discounting processes. *Addiction, 96*(1), 73-86.

- Black, A. C., & Rosen, M. I. (2011). A money management-based substance use treatment increases valuation of future rewards. *Addictive Behaviors*, *36*(1-2), 125-128.
- Borsari, B., Hustad, J. T., Mastroleo, N. R., Tevyaw, T. O. L., Barnett, N. P., Kahler, C. W., ... & Monti, P. M. (2012). Addressing alcohol use and problems in mandated college students: A randomized clinical trial using stepped care. *Journal of Consulting and Clinical Psychology*, *80*(6), 1062.
- Borsari, B., Murphy, J. G., & Carey, K. B. (2009). Readiness to change in brief motivational interventions: A requisite condition for drinking reductions? *Addictive Behaviors*, *34*(2), 232-235.
- Cassidy, R. N., Bernstein, M. H., Magill, M., MacKillop, J., Murphy, J. G., & Colby, S. M. (2019). Alcohol demand moderates brief motivational intervention outcomes in underage young adult drinkers. *Addictive Behaviors*, *98*, 106044.
- Carey, K. B., Carey, M. P., Maisto, S. A., & Henson, J. M. (2006). Brief motivational interventions for heavy college drinkers: A randomized controlled trial. *Journal of Consulting and Clinical Psychology*, *74*(5), 943.
- Carey, K. B., Scott-Sheldon, L. A., Carey, M. P., & DeMartini, K. S. (2007). Individual-level interventions to reduce college student drinking: A meta-analytic review. *Addictive Behaviors*, *32*(11), 2469-2494.
- Carvalho, J. P., Gawrysiak, M. J., Hellmuth, J. C., McNulty, J. K., Magidson, J. F., Lejuez, C. W., & Hopko, D. R. (2011). The Reward Probability Index: Design and validation of a scale measuring access to environmental reward. *Behavior Therapy*, *42*(2), 249-262.
- Cellucci, T., Krogh, J., & Vik, P. (2006). Help seeking for alcohol problems in a college population. *The Journal of General Psychology*, *133*(4), 421-433.

- Cohen, E., Feinn, R., Arias, A., & Kranzler, H. R. (2007). Alcohol treatment utilization: Findings from the national epidemiologic survey on alcohol and related conditions. *Drug and Alcohol Dependence*, *86*(2-3), 214-221.
- Collins, R. L., Parks, G. A., & Marlatt, G. A. (1985). Social determinants of alcohol consumption: The effects of social interaction and model status on the self-administration of alcohol. *Journal of Consulting and Clinical Psychology*, *53*(2), 189.
- Collins, S. E., Witkiewitz, K., & Larimer, M. E. (2011). The theory of planned behavior as a predictor of growth in risky college drinking. *Journal of Studies On Alcohol and Drugs*, *72*(2), 322-332.
- Correia, C. J., Carey, K. B., Simons, J., & Borsari, B. E. (2003). Relationships between binge drinking and substance-free reinforcement in a sample of college students: A preliminary investigation. *Addictive Behaviors*, *28*(2), 361-368.
- Cronce, J. M., & Larimer, M. E. (2011). Individual-focused approaches to the prevention of college student drinking. *Alcohol Research & Health*, *34*(2), 210.
- Daugherty, J. R., & Brase, G. L. (2010). Taking time to be healthy: Predicting health behaviors with delay discounting and time perspective. *Personality and Individual Differences*, *48*(2), 202-207.
- Dennhardt, A. A., Yurasek, A. M., & Murphy, J. G. (2015). Change in delay discounting and substance reward value following a brief alcohol and drug use intervention. *Journal of the Experimental Analysis of Behavior*, *103*(1), 125-140.
- Elliott, M. A., & Ainsworth, K. (2012). Predicting university undergraduates' binge-drinking behavior: A comparative test of the one-and two-component theories of planned behavior. *Addictive Behaviors*, *37*(1), 92-101.

- Epler, A. J., Sher, K. J., Loomis, T. B., & O'Malley, S. S. (2009). College student receptiveness to various alcohol treatment options. *Journal of American College Health, 58*(1), 26-32.
- Gray, J. C., & MacKillop, J. (2015). Using behavior economics to understand alcohol use disorders: A concise review and identification of research priorities. *Current Addiction Reports, 2*(1), 68-75.
- Gaume, J., Bertholet, N., Faouzi, M., Gmel, G., & Daepfen, J. B. (2013). Does change talk during brief motivational interventions with young men predict change in alcohol use? *Journal of Substance Abuse Treatment, 44*(2), 177-185.
- Hayes, A. F. (2016). The PROCESS macro for SPSS and SAS.
- Hingson, R., Zha, W., & Smyth, D. (2017). Magnitude and trends in heavy episodic drinking, alcohol-impaired driving, and alcohol-related mortality and overdose hospitalizations among emerging adults of college ages 18–24 in the United States, 1998–2014. *Journal of Studies on Alcohol and Drugs, 78*(4), 540-548.
- Huh, D., Mun, E. Y., Larimer, M. E., White, H. R., Ray, A. E., Rhew, I. C., ... & Atkins, D. C. (2015). Brief motivational interventions for college student drinking may not be as powerful as we think: An individual participant-level data meta-analysis. *Alcoholism: Clinical and Experimental Research, 39*(5), 919-931.
- Hursh, S. R., Galuska, C. M., Winger, G., & Woods, J. H. (2005). The economics of drug abuse: A quantitative assessment of drug demand. *Molecular Interventions, 5*(1), 20.
- Johnson, M. W., Bickel, W. K., Baker, F., Moore, B. A., Badger, G. J., & Budney, A. J. (2010). Delay discounting in current and former marijuana-dependent individuals. *Experimental and Clinical Psychopharmacology, 18*(1), 99.

- Johnson, S.B., Blum, R.W., and Giedd, J.N (2009). Adolescent maturity and the brain: The promise and pitfalls of neuroscience research in adolescent health policy. *Journal of Adolescent Health, 45*(3):216–221.
- Joyner, K. J., Acuff, S. F., Meshesha, L. Z., Patrick, C. J., & Murphy, J. G. (2018). Alcohol family history moderates the association between evening substance-free reinforcement and alcohol problems. *Experimental and Clinical Psychopharmacology, 26*(6), 560.
- Joyner, K. J., Pickover, A. M., Soltis, K. E., Dennhardt, A. A., Martens, M. P., & Murphy, J. G. (2016). Deficits in access to reward are associated with college student alcohol use disorder. *Alcoholism: Clinical and Experimental Research, 40*(12), 2685-2691.
- Kavanaugh, M. L., & Schwarz, E. B. (2009). Prospective assessment of pregnancy intentions using a single-versus a multi-item measure. *Perspectives on Sexual and Reproductive Health, 41*(4), 238-243.
- Kiselica, A. M., & Borders, A. (2013). The reinforcing efficacy of alcohol mediates associations between impulsivity and negative drinking outcomes. *Journal of Studies on Alcohol and Drugs, 74*(3), 490-499.
- Kivlahan, D. R., Marlatt, G. A., Fromme, K., Coppel, D. B., & Williams, E. (1990). Secondary prevention with college drinkers: Evaluation of an alcohol skills training program. *Journal of Consulting and Clinical Psychology, 58*(6), 805.
- Komiya, N., Good, G. E., & Sherrod, N. B. (2000). Emotional openness as a predictor of college students' attitudes toward seeking psychological help. *Journal of Counseling Psychology, 47*(1), 138.

- Lemley, S. M., Kaplan, B. A., Reed, D. D., Darden, A. C., & Jarmolowicz, D. P. (2016). Reinforcer pathologies: Predicting alcohol related problems in college drinking men and women. *Drug and Alcohol Dependence, 167*, 57-66.
- Loree, A. M., Lundahl, L. H., & Ledgerwood, D. M. (2015). Impulsivity as a predictor of treatment outcome in substance use disorders: Review and synthesis. *Drug and Alcohol Review, 34*(2), 119-134.
- MacKillop, J., & Kahler, C. W. (2009). Delayed reward discounting predicts treatment response for heavy drinkers receiving smoking cessation treatment. *Drug and Alcohol Dependence, 104*(3), 197-203.
- MacKillop, J., Miranda Jr, R., Monti, P. M., Ray, L. A., Murphy, J. G., Rohsenow, D. J., ... & Gwaltney, C. J. (2010). Alcohol demand, delayed reward discounting, and craving in relation to drinking and alcohol use disorders. *Journal of Abnormal Psychology, 119*(1), 106.
- MacKillop, J., & Murphy, J. G. (2007). A behavioral economic measure of demand for alcohol predicts brief intervention outcomes. *Drug and Alcohol Dependence, 89*(2-3), 227-233.
- Magill, M., Colby, S. M., Orchowski, L., Murphy, J. G., Hoadley, A., Brazil, L. A., & Barnett, N. P. (2017). How does brief motivational intervention change heavy drinking and harm among underage young adult drinkers? *Journal of Consulting and Clinical Psychology, 85*(5), 447.
- Mechanisms of Behavior Change Satellite Committee. (2018). Novel approaches to the study of mechanisms of behavior change in alcohol and other drug use disorders. *Journal of Studies on Alcohol and Drugs, 79*(2), 159-162.

- Merrill, J. E., & Carey, K. B. (2016). Drinking over the lifespan: Focus on college ages. *Alcohol Research: Current Reviews*.
- Miller, W. R., & Rollnick, S. (2012). *Motivational interviewing: Helping people change*. Guilford press.
- Murphy, J. G., Barnett, N. P., Goldstein, A. L., & Colby, S. M. (2007). Gender moderates the relationship between substance-free activity enjoyment and alcohol use. *Psychology of Addictive Behaviors, 21*(2), 261.
- Murphy, J. G., & Dennhardt, A. A. (2016). The behavioral economics of young adult substance abuse. *Preventive Medicine, 92*, 24-30.
- Murphy, J. G., Dennhardt, A. A., Martens, M. P., Borsari, B., Witkiewitz, K., & Meshesha, L. Z. (2019). A randomized clinical trial evaluating the efficacy of a brief alcohol intervention supplemented with a substance-free activity session or relaxation training. *Journal of Consulting and Clinical Psychology*.
- Murphy, J. G., Dennhardt, A. A., Skidmore, J. R., Borsari, B., Barnett, N. P., Colby, S. M., & Martens, M. P. (2012). A randomized controlled trial of a behavioral economic supplement to brief motivational interventions for college drinking. *Journal of Consulting and Clinical Psychology, 80*(5), 876.
- Murphy, J. G., Dennhardt, A. A., Skidmore, J. R., Martens, M. P., & McDevitt-Murphy, M. E. (2010). Computerized versus motivational interviewing alcohol interventions: Impact on discrepancy, motivation, and drinking. *Psychology of Addictive Behaviors, 24*(4), 628.
- Murphy, J. G., Dennhardt, A. A., Yurasek, A. M., Skidmore, J. R., Martens, M. P., MacKillop, J., & McDevitt-Murphy, M. E. (2015). Behavioral economic predictors of brief alcohol intervention outcomes. *Journal of Consulting and Clinical Psychology, 83*(6), 1033.

- Murphy, J. G., & MacKillop, J. (2006). Relative reinforcing efficacy of alcohol among college student drinkers. *Experimental and Clinical Psychopharmacology*, *14*(2), 219.
- Murphy, J. G., MacKillop, J., Skidmore, J. R., & Pederson, A. A. (2009). Reliability and validity of a demand curve measure of alcohol reinforcement. *Experimental and Clinical Psychopharmacology*, *17*(6), 396.
- Murphy, J. G., McDevitt-Murphy, M. E., & Barnett, N. P. (2005). Drink and be merry? Gender, life satisfaction, and alcohol consumption among college students. *Psychology of Addictive Behaviors*, *19*(2), 184.
- Norman, P., & Conner, M. (2006). The theory of planned behaviour and binge drinking: Assessing the moderating role of past behaviour within the theory of planned behaviour. *British Journal of Health Psychology*, *11*(1), 55-70.
- Pettinati, H. M., O'Brien, C. P., Rabinowitz, A. R., Wortman, S. P., Oslin, D. W., Kampman, K. M., & Dackis, C. A. (2006). The status of naltrexone in the treatment of alcohol dependence: Specific effects on heavy drinking. *Journal of Clinical Psychopharmacology*, *26*(6), 610-625.
- Read, J. P., Kahler, C. W., Strong, D. R., & Colder, C. R. (2006). Development and preliminary validation of the young adult alcohol consequences questionnaire. *Journal of studies on alcohol*, *67*(1), 169-177.
- Read, J. P., Merrill, J. E., Kahler, C. W., & Strong, D. R. (2007). Predicting functional outcomes among college drinkers: Reliability and predictive validity of the Young Adult Alcohol Consequences Questionnaire. *Addictive Behaviors*, *32*(11), 2597-2610.

- Rhodes, R. E., Blanchard, C. M., Matheson, D. H., & Coble, J. (2006). Disentangling motivation, intention, and planning in the physical activity domain. *Psychology of Sport and Exercise*, 7(1), 15-27.
- Skidmore, J. R., & Murphy, J. G. (2010). Relations between heavy drinking, gender, and substance-free reinforcement. *Experimental and Clinical Psychopharmacology*, 18(2), 158.
- Skidmore, J. R., Murphy, J. G., & Martens, M. P. (2014). Behavioral economic measures of alcohol reward value as problem severity indicators in college students. *Experimental and Clinical Psychopharmacology*, 22(3), 198.
- Smith, A. E., Martens, M. P., Murphy, J. G., Buscemi, J., Yurasek, A. M., & Skidmore, J. (2010). Reinforcing efficacy moderates the relationship between impulsivity-related traits and alcohol use. *Experimental and Clinical Psychopharmacology*, 18(6), 521.
- Strathman, A., Gleicher, F., Boninger, D. S., & Edwards, C. S. (1994). The consideration of future consequences: Weighing immediate and distant outcomes of behavior. *Journal of Personality and Social Psychology*, 66(4), 742.
- Strickland, J. C., Lile, J. A., & Stoops, W. W. (2017). Unique prediction of cannabis use severity and behaviors by delay discounting and behavioral economic demand. *Behavioural Processes*, 140, 33-40.
- Substance Abuse and Mental Health Services Administration (SAMHSA)(2015). *National Survey on Drug Use and Health (NSDUH)*.
- Tabachnick, B.G., & Fidell, L.S. Using multivariate statistics. *Pearson Education Inc.*; 2012.

- Tanner-Smith, E. E., & Lipsey, M. W. (2015). Brief alcohol interventions for adolescents and young adults: A systematic review and meta-analysis. *Journal of Substance Abuse Treatment, 51*, 1-18.
- Teeters, J. B., Pickover, A. M., Dennhardt, A. A., Martens, M. P., & Murphy, J. G. (2014). Elevated alcohol demand is associated with driving after drinking among college student binge drinkers. *Alcoholism: Clinical and Experimental Research, 38*(7), 2066-2072.
- Tucker, J. A., Roth, D. L., Vignolo, M. J., & Westfall, A. O. (2009). A behavioral economic reward index predicts drinking resolutions: Moderation revisited and compared with other outcomes. *Journal of Consulting and Clinical Psychology, 77*(2), 219.
- Vader, A. M., Walters, S. T., Prabhu, G. C., Houck, J. M., & Field, C. A. (2010). The language of motivational interviewing and feedback: counselor language, client language, and client drinking outcomes. *Psychology of Addictive Behaviors, 24*(2), 190.
- Voss, A. T., Soltis, K. E., Dennhardt, A. A., Martens, M. P., & Murphy, J. G. (2018). Protective behavioral strategies mediate the relationship between behavioral economic risk factors and alcohol-related problems. *Experimental and Clinical Psychopharmacology, 26*(1), 58.
- Walters, S. T., & Neighbors, C. (2005). Feedback interventions for college alcohol misuse: What, why and for whom? *Addictive Behaviors, 30*(6), 1168-1182.
- Webb, T. L., & Sheeran, P. (2006). Does changing behavioral intentions engender behavior change? A meta-analysis of the experimental evidence. *Psychological Bulletin, 132*(2), 249.

Appendix

Table 1

Descriptive Statistics and Bivariate Correlations

Variable	Range	Mean	SD	Skew/Kurtosis	1	2	3	4	5	6
1. Consumption†	0-63	16.3	11.7	0.78/0.60	-					
2. YAACQ†	0-38	13.0	7.7	0.64/0.11	.35**	-				
3. Intention	1-10	6.4	2.7	-0.47/-0.84	.06	.31**	-			
4. RPI-ESS	9-36	22.7	7.3	-0.03/-1.14	-.04	-.07	-.06	-		
5. CFC	13-44	30.5	6.5	-0.40/-0.42	-.01	-.14*	.02	.10	-	
6. Intensity	2-23	8.4	4.0	1.34/1.71	.60**	.22**	.00	-.03	-.04	-
7. O _{max}	1-43	16.0	8.7	1.12/1.22	.23**	.09	-.03	-.08	-.06	.35**

Note. Range, mean, and standard deviations are prior to square root transformation. Consumption = Typical Weekly Alcohol Consumption at baseline; YAACQ = Young Adult Alcohol Consequences Questionnaire at baseline; RPI-ESS = Reward Probability Index – Environmental Suppressor Subscale; CFC = Consideration of Future Consequences.

† = variable transformed

* $p < 0.05$

** $p < 0.01$

Table 2

Summary of Models Predicting Typical Weekly Drinking Moderated by Behavioral Economic Variables at 1-month Follow-up

Step	Models	<i>R</i>	ΔR^2	<i>F</i>	<i>df</i>	β	<i>SE</i>	<i>p</i>	95% CI	
	Model 1**	.74	.55	33.65	7, 197			<.001		
1	Site					.252	.132	.057	-.008	.511
	Condition					.020	.126	.875	-.229	.269
	Gender					-.245	.142	.087	-.525	.036
	Baseline TWD**					.632	.052	<.001	.530	.736
2	Intention**					-.112	.024	<.001	-.160	-.065
3	RPI-ESS					.002	.008	.843	-.015	.018
4	Intention x RPI-ESS*		.01	4.76	1, 197	.007	.003	.030	.001	.013
	Model 2**	.73	.53	33.34	7, 210			<.001		
1	Site*					.028	.129	.030	.028	.538
	Condition					.015	.124	.901	-.228	.259
	Gender*					-.300	.137	.030	-.570	-.029
	Baseline TWD**					.602	.051	<.001	.502	.703
2	Intention**					-.124	.024	<.001	-.171	-.077
3	CFC					-.018	.001	.057	-.037	.001
4	Intention x CFC		<.001	0.12	1, 210	.733	.004	.733	-.006,	.009
	Model 3**	.75						<.001		
1	Site*	.75	.57	38.76	7, 208	.313	.125	.013	.066	.559
	Condition					.046	.120	.701	-.191	.283
	Gender					-.219	.137	.113	-.490	.052
	Baseline TWD**					.497	.059	<.001	.380	.614
2	Intention**					-.122	.023	<.001	-.168	-.076
3	Intensity**					.061	.019	.001	.024	.097
4	Intention x Intensity**		.02	11.36	1, 208	-.020	.006	.001	-.032,	-.008
	Model 4**	.74	.54	35.39	7, 208			<.001		
1	Site*					.305	.129	.019	.051	.559
	Condition					.027	.124	.827	-.217	.271
	Gender*					-.277	.138	.045	-.548	-.006
	Baseline TWD**					.600	.053	<.001	.495	.705
2	Intention**					-.129	.024	<.001	-.176	-.081
3	O _{max}					.008	.007	.287	-.007	.023
4	Intention x O _{max} *		.02	7.76	1, 208	-.008	.003	.006	-.013	-.002
	Model 5**	.73	.53	39.56	6, 211			<.001		
1	Gender**					-.276	.136	.044	-.545	-.007
	Site					.241	.128	.061	-.012	.494
	Baseline TWD**					-.616	.051	<.001	.516	.716
2	Intention**					-.125	.024	<.001	-.172	-.078
3	Condition					.021	.123	.865	-.221	.263
4	Intention x Condition*		.011	5.066	1, 211	-.102	.045	.025	-.192	-.013

Table 2 (Continued)

Note. RPI-ESS = Reward Probability Index – Environment Suppressor Subscale; CFC= Consideration of Future Consequences; TWD = Typical Weekly Drinking (variable square root transformed)

* $p < .05$

** $p < .001$

Table 3

Summary of Models Predicting Alcohol-Related Consequences Moderated by Behavioral Economic Variables at 1-month Follow-up

Step	Models	<i>R</i>	ΔR^2	<i>F</i>	<i>df</i>	β	<i>SE</i>	<i>p</i>	95% CI
	Model 6**	.59	.35	15.41	7, 197			<.001	
1	Site*					.494	.142	.001	.215 .774
	Condition					.120	.134	.371	-.144 .385
	Gender*					-.301	.143	.037	-.583 -.019
	Baseline ARC**					.587	.067	<.001	.455 .720
2	Intention					-.045	.466	.103	-.100 .009
3	RPI-ESS					-.004	.009	.638	-.022 .014
4	Intention x RPI-ESS		<.001	0.13	1, 197	.001	.003	.714	-.005 .008
	Model 7**	.61	.38	18.16	7, 210			<.001	
1	Site**					.517	.136	<.001	.250 .785
	Condition					.074	.128	.563	-.178 .326
	Gender*					-.309	.135	.023	-.575 -.043
	Baseline ARC**					.591	.065	<.001	.462 .719
2	Intention					-.046	.027	.083	-.099 .006
3	CFC*					-.022	.010	.032	-.042 -.002
4	Intention x CFC		.007	2.20	1, 210	.006	.004	.139	-.019 .013
	Model 8**	.61	.38	18.00	7, 208			<.001	
1	Site**					.488	.136	<.001	.219 .757
	Condition					.072	.129	.579	-.183 .327
	Gender					-.173	.149	.248	-.466 .121
	Baseline ARC**					.575	.066	<.001	.444 .706
2	Intention*					-.053	.027	.049	-.106 <.001
3	Intensity*					.042	.018	.020	.007 .078
4	Intention x Intensity		.007	2.20	1, 210	-.006	.007	.377	-.019 .007
	Model 9**	.60	.36	16.98	7, 208			<.001	
1	Site**					.497	.138	<.001	.224 .769
	Condition					.099	.131	.451	-.159 .356
	Gender*					-.286	.139	.041	-.560 -.012
	Baseline ARC**					.604	.066	<.001	.474 .733
2	Intention*					-.054	.027	.050	-.108 <.001
3	O _{max}					.009	.008	.234	-.006 .025
4	Intention x O _{max}		<.001	0.22	1, 208	-.001	.003	.639	-.007 .005

Note. RPI-ESS = Reward Probability Index – Environment Suppressor Subscale; CFC= Consideration of Future Consequences; ARC = Alcohol-Related Consequences (variable square root transformed)

**p* < .05

***p* < .001

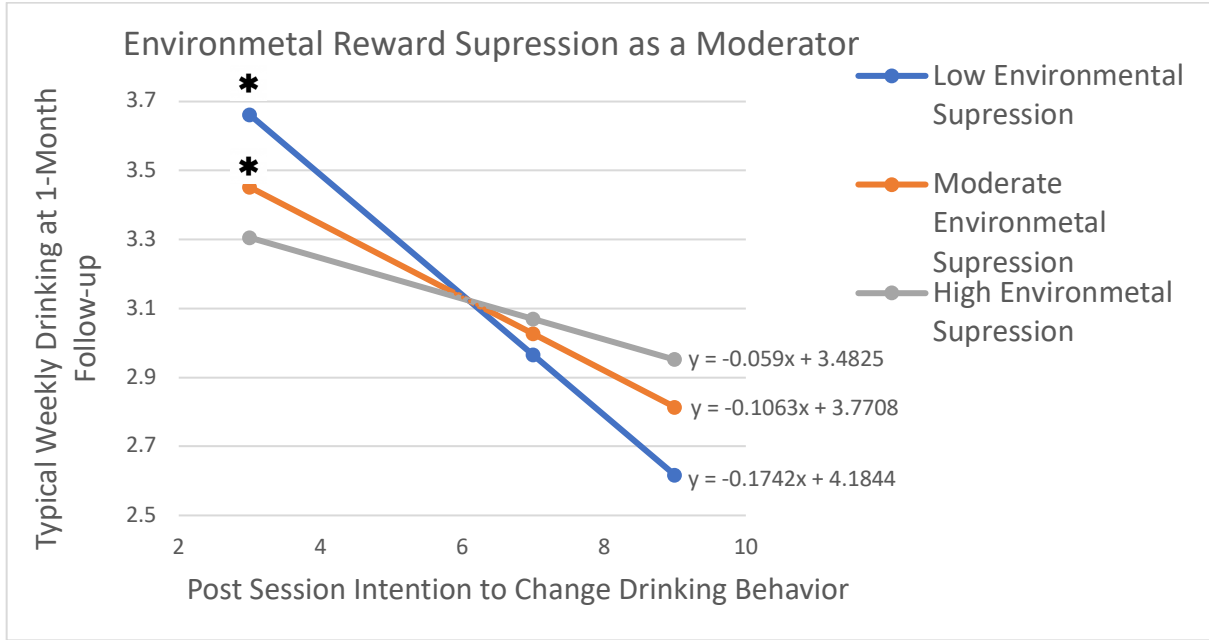


Figure 1. Environmental reward suppression significantly moderates the relationship between level of intention to change drinking behavior and typical weekly drinking at follow-up (square root transformation). The association between intention to change and follow-up drinking was significant for individuals with moderate and low environmental suppression (i.e., moderate and high levels of reward) at baseline. Analysis consisted of post-intervention intention to change predicting changes in typical weekly drinking (i.e., daily drinking questionnaire) at 1-month follow-up moderated by levels of environmental suppression. The analysis controlled for site, gender, treatment condition, and baseline typical weekly drinking (square root transformation). The analysis mean centered variables and consisted of a nonparametric bootstrapping method of 5000 samples set at 95% confidence intervals. Hayes' Process Macro provided Johnson-Neyman output to probe for significant interactions and generate plots in SPSS. Environmental values in the conditional tables used to plot the graphs are in the 16th, 50th, and 84th percentiles and were labeled as low, moderate, and high levels.

* $p < .05$

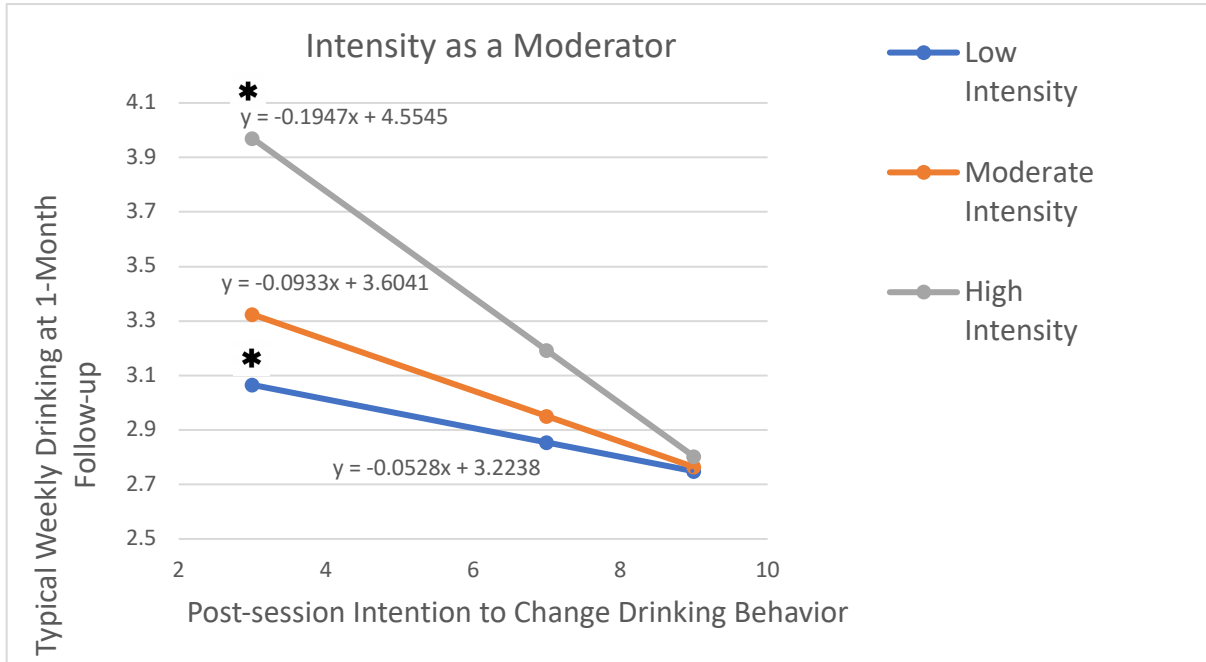


Figure 2. Alcohol demand significantly moderates the relationship between level of intention to change drinking behavior and typical weekly drinking at follow-up (square root transformation). The association between intention to change and follow-up drinking was significant for individuals with moderate and high levels of intensity (i.e., moderate and high consumption of alcohol when drinks are free) at baseline. Analysis consisted of post-intervention intention to change predicting changes in typical weekly drinking (i.e., daily drinking questionnaire) at 1-month follow-up moderated by levels of alcohol demand. The analysis controlled for site, gender, treatment condition, and baseline typical weekly drinking (square root transformation). The analysis mean centered variables and consisted of a nonparametric bootstrapping method of 5000 samples set at 95% confidence intervals. Hayes' Process Macro provided Johnson-Neyman output to probe for significant interactions and generate plots in SPSS. Alcohol demand (i.e., intensity) in the conditional tables used to plot the graphs are in the 16th, 50th, and 84th percentiles and were labeled as low, moderate, and high levels.

* $p < .05$

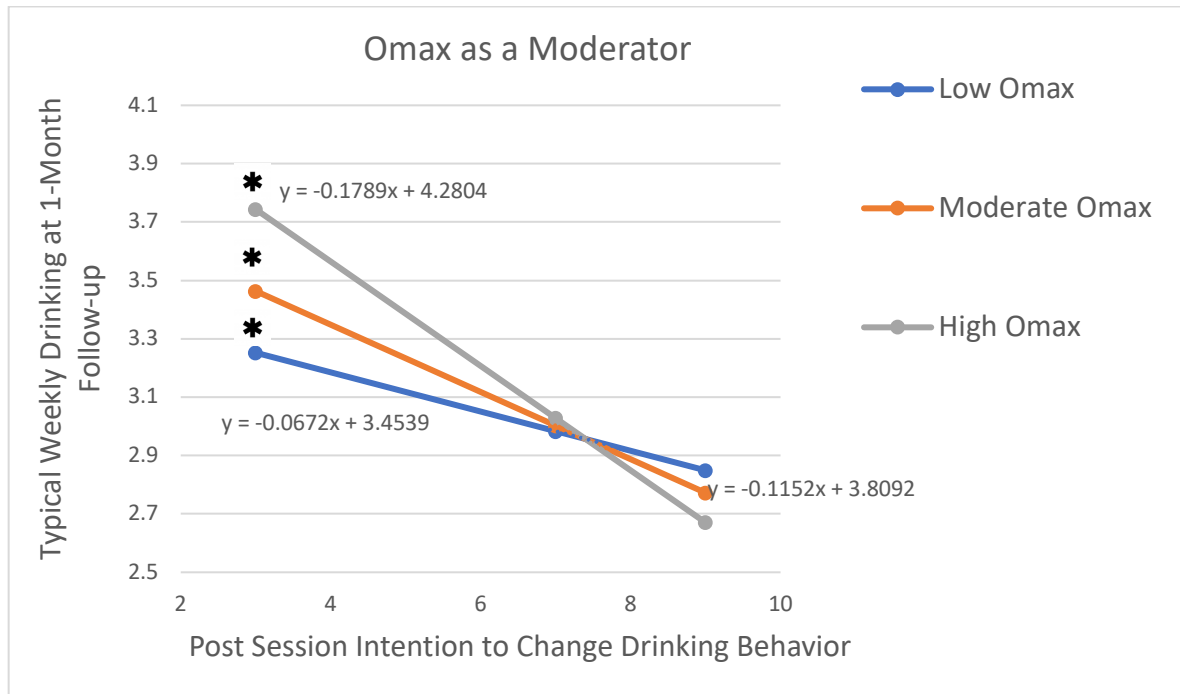


Figure 3. O_{max} significantly moderates the relationship between level of intention to change drinking behavior and typical weekly drinking at follow-up (square root transformation). The association between intention to change and follow-up drinking was significant for individuals with low, moderate, and high levels O_{max} (i.e., all levels of maximum alcohol expenditure) at baseline. Analysis consisted of post-intervention intention to change predicting changes in typical weekly drinking (i.e., daily drinking questionnaire) at 1-month follow-up moderated by levels of O_{max}. The analysis controlled for site, gender, treatment condition, and baseline typical weekly drinking (square root transformation). The analysis mean centered variables and consisted of a nonparametric bootstrapping method of 5000 samples set at 95% confidence intervals. Hayes' Process Macro provided Johnson-Neyman output to probe for significant interactions and generate plots in SPSS. O_{max} values in the conditional tables used to plot the graphs are in the 16th, 50th, and 84th percentiles and were labeled as low, moderate, and high levels.

* $p < .05$