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A Randomized Controlled Trial of a Behavioral Economic Supplement to Brief Motivational Interventions for College Drinking

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Abstract

Objective—Behavioral economic theory suggests that a reduction in substance use is most likely when there is an increase in rewarding substance-free activities. The goal of this randomized controlled clinical trial was to evaluate the incremental efficacy of a novel behavioral economic supplement (Substance-Free Activity Session, SFAS) to a standard alcohol brief motivational interviewing (BMI) session for heavy drinking college students.

Method—Participants were 82 first-year college students (50% female, 81.7% White/European American, Mean age = 18.5 years, *SD* = .71) who reported two or more past-month heavy drinking episodes. After completing a baseline assessment and an individual alcohol-focused BMI, participants were randomized to either the SFAS or to a Relaxation Training (RT) control session. The SFAS was delivered in an MI style and attempted to increase the salience of delayed academic and career rewards and the patterns of behavior leading to those rewards.

Results—The combination of an alcohol BMI plus the SFAS was associated with significantly greater reductions in alcohol problems compared to an alcohol BMI plus RT at the 1-month and 6-month follow-up assessments ($p = .015$, $\eta_p^2 = .07$), an effect that was partially mediated by increases in protective behavioral strategies. BMI + SFAS was also associated with greater reductions in heavy drinking among participants who at baseline reported low levels of substance-free reinforcement or symptoms of depression.

Conclusion—These results are consistent with behavioral economic theory and suggest that a single session focused on increasing engagement in alternatives to drinking can enhance the effects of brief alcohol interventions.

Keywords

alcohol; behavioral economics; binge drinking; college; motivational interventions; substance-free reinforcement

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Approximately 31.3% of college women and 45.3% of college men report engaging in heavy episodic drinking (≥ 5/4 drinks in one sitting for men/women) at least once in the preceding two weeks (Johnston, O'Malley, Bachman, & Schulenberg, 2010). These heavy drinking episodes can result in significant intoxication, impaired judgment and decision making, and dangerously high blood alcohol concentrations. Heavy drinkers are also less engaged in academics during college, and finish with lower grades than other students (Singleton, 2007).

Interventions for College Student Drinking

The most promising interventions for college student drinkers include personalized feedback about current drinking patterns in relation to normative drinking, blood alcohol content (BAC), alcohol-related risks, and harm reduction strategies delivered using a motivational interviewing (MI) style (Miller & Rollnick, 2002). These brief motivational interventions (BMIs) result in drinking reductions that exceed various control conditions (Cronce & Larimer, 2011), but effect sizes of these interventions relative to control conditions are generally small to moderate (*d*s = .11 – .40), and many students who receive a BMI continue to drink heavily and experience alcohol-related problems (Carey, Scott-Sheldon, Carey, & DeMartini, 2007; Moreira, Smith, & Foxcroft, 2009). Providing relatively longer BMI sessions (e.g., 10 vs. 50 minutes; Kulesza, Apperson, Larimer, & Copeland, 2010), or booster sessions (Barnett, Murphy, Colby, & Monti, 2007) does not appear to improve outcomes.

Improving Interventions for College Drinking with a Behavioral Economic Supplement

There is a need to improve the efficacy of BMIs while maintaining the brief format, but there has been little theoretically-based research that has addressed this goal. Behavioral economic research has focused on studying patterns of substance abuse as they develop and change over time in the context of changes in access to substance use and to other activities. In general, the *value* a person places on a substance is a function of the benefit/cost ratio of substance use in relation to the benefit/cost ratios of other available activities. The behavioral economic mechanisms of substance-free reinforcement and delayed reward discounting have demonstrated relations to substance use (Murphy, Correia, & Barnett, 2007; Tucker, Roth, Vignolo, & Westfall, 2009) and may have relevance to efforts to improve brief interventions.

Substance-free reinforcement

Experimental studies have shown that high rates of substance use are most likely in contexts that are devoid of substance-free sources of reinforcement (Carroll, Anker, & Perry, 2009), and that substance use will generally decrease if access to alternative reinforcers is increased (Higgins, Heil, & Lussier, 2004). These basic research findings have led to efficacious interventions such as contingency management and community reinforcement. However, these intensive treatments require substantial resources on the part of the treatment provider and the participant and may have limited relevance for most college drinkers, who report low rates of help seeking for alcohol problems (Buscemi et al., 2010).

A small but growing body of research suggests that it may be possible to increase substance-free activities using a brief intervention approach, and that change in these alternative behaviors may precipitate change in drinking (Murphy et al., 2012). An experimental study that did not include an alcohol intervention found that college students who were instructed to increase substance-free behaviors (exercise or creative activities) reported doing so, and also reduced drinking compared to control participants (Correia, Benson, & Carey, 2005).

Additionally, Murphy, Correia, Colby, & Vuchinich (2005) found that participants in a BMI trial who derived a smaller proportion of their total reinforcement from substance use at baseline reported lower levels of follow-up drinking, even after controlling for their baseline drinking level. This study also found that students who reduced their drinking by at least 5 drinks per week showed increased reinforcement from substance-free activities at follow up, and specifically academic activity.

Delayed reward discounting

Young adults who drink heavily may under-engage in constructive alternatives to drinking because the benefits of these activities are generally delayed. Although the value of all rewards decrease as their receipt is delayed, there are substantial individual differences in the degree that delayed rewards are discounted. This delayed reward discounting (DRD) phenomenon may be a core feature of substance abuse (Madden & Bickel, 2010; Vuchinich & Simpson, 1998): Whereas alcohol generally provides immediate reinforcement (e.g., anxiety reduction, euphoria, social facilitation), many substance-free academic and career-related activities (e.g., attending class and studying) are associated with delayed outcomes (e.g., graduation, career success) and are generally not as enjoyable in the short run (Murphy, Barnett, & Colby, 2006). Students who sharply discount the value of delayed academic and career outcomes may be less likely to engage in the behaviors necessary for success in these domains and may instead allocate their behavior toward more immediately reinforcing activities such as consuming alcohol. Indeed, numerous studies have demonstrated that substance abusers discount the value of delayed rewards more steeply than control participants (MacKillop et al., 2010) and that impulsivity or difficulty with self-regulation is associated with poor response to substance abuse treatment (Carey, Henson, Carey, & Maisto, 2007; Feldstein Ewing, LaChance, Bryan, & Hutchison, 2009; MacKillop & Kahler, 2009).

Behavioral economic laboratory research suggests that increasing the salience of delayed outcomes, and the extent to which the behavior leading to those rewards or punishers is viewed as part of a coherent pattern (rather than an isolated choice), can reduce impulsive response patterns (Hofmeyr, Ainslie, Charlton, & Ross, 2011; Siegel & Rachlin, 1995). One clinical implication of this research is that, short of creating immediate and powerful alternatives to substance use through intensive contingency management approaches (Higgins et al., 2004), or cognitive rehabilitation to reduce impulsivity (Bickel, Landes, Hill, & Baxter, 2011), interventions might attempt to encourage substance abusers to view their day-to-day behavior as comprising patterns leading towards long term outcomes (Logue, 2000). Motivational interviewing, which includes a focus on developing discrepancy between current behavior and long-term goals, and if often paired with objective feedback on behavior patterns, might be an especially useful approach for achieving this clinical aim. Feedback and discussion related to the long-term implications of substance-related and substance-free behavior patterns might contribute to motivation to change substance use above and beyond the standard focus on substance-related risk.

The Current Study

The studies reviewed above suggest that heavy drinking in college students is often associated with under-engagement in substance-free activities, especially academic and career-related activities that are associated with delayed reinforcement. Murphy et al. (2005) found that individuals with few rewarding alternatives to drinking are less likely to respond to existing BMIs, and individuals who reduce their drinking following a BMI tend to increase their engagement in constructive activities. Therefore, the present study evaluated the hypothesis that the combination of a standard alcohol BMI and a Substance-Free Activity Session (SFAS) which uses MI and personalized feedback to target the behavioral

economic mechanisms of substance-free reinforcement and delayed reward discounting would result in greater drinking reductions than a standard alcohol BMI plus a relaxation training control session. Because the SFAS includes a specific focus on increasing goal-directed behavior associated with delayed academic or career rewards, and earlier work has established that drinkers who are depressed, impulsive, or report lower levels of substance-free reinforcement show poor response to standard alcohol BMIs, we hypothesized that BMI + SFAS would be especially effective for students with these characteristics. A secondary goal of this study was to measure proximal outcomes associated with the SFAS and to evaluate their role as possible mediators of treatment effects.

Method

Participants

Participants were undergraduate students from a public university in the southern United States. Students enrolled in university-wide introductory classes complete a brief screening survey and were invited to participate if they were full-time freshman, between the ages of 18 and 21 years old, reported two or more heavy drinking episodes (≥ 5/4 drinks on one occasion for a man/woman) in the past month, and worked fewer than 20 hours per week. The latter criterion was included to select for "typical" college students who have time for potential increases in academic/extra-curricular activities. Two-hundred ten students were eligible and 82 (39%) agreed to participate (See Figure 1). Of the 82 participants (50% men; Mean age = 18.51, *SD* = .71), 81.7% self-identified as White/European American, 12.2% as Black/African-American, 2.4% as Hispanic/Latino, 1.2% as Asian, and 1.2% as Native American (categories were not mutually exclusive). Participants received $40 for completing the baseline assessment and the two intervention sessions (the payment was made after the 2nd intervention session) and $20 for completing each of the two follow-up (i.e., total study payment was a maximum of $80).

Measures

Alcohol consumption—The Daily Drinking Questionnaire (DDQ; Collins, Parks, & Marlatt, 1985) was used to measure alcohol consumption. Participants reported the total number of standard drinks that they consumed on each day during a typical week in the past month. The sum of these days was used to create an estimate of typical weekly drinking. The DDQ is a reliable measure in college students and is highly correlated with self-monitored drinking reports (Kivlahan, Marlatt, Fromme, Coppel, & Williams, 1990). Participants also were asked to report their number of past-month heavy drinking episodes.

Alcohol problems—Alcohol-related problems were assessed using the Young Adult Alcohol Consequences Questionnaire (YAACQ; Read, Merrill, Kahler, & Strong, 2007). Participants indicate which items on a list of 49 potential problems they have experienced as a result of their drinking in the past month. The YAACQ has demonstrated good reliability and validity with college students (Read et al., 2007). Internal consistency for the YAACQ at baseline and follow-ups was excellent (.91 – .95).

Substance-free reinforcement—The Adolescent Reinforcement Survey Schedule–Substance Use Version (ARSS-SUV; Murphy et al. 2005) was used to measure past-month reinforcement from substance-related and substance-free activities. Participants rated their past-month activity frequency and enjoyment ratings for 38 activities on 5-point Likert scales. Frequency ratings ranged from 0 (*zero times per week*) to 4 (*more than once per day*), and enjoyment ratings ranged from 0 (*unpleasant or neutral*) to 4 (*extremely pleasant*). The list of activities included social/leisure, dating, family, and school-related activities. Participants completed two frequency and enjoyment ratings for each activity; one for

activities that included alcohol or drug use and one for activities that did not include alcohol or drug use. The frequency and enjoyment ratings were multiplied to obtain a cross-product score that reflects reinforcement derived from the activity. The substance-free cross products were averaged to create a summary score that reflects the average reinforcement from all substance-free activities. This substance-free total score was examined as a mediator of treatment outcomes since it was expected to change as a function of SFAS intervention, and as a moderator of intervention efficacy, since individuals with low reinforcement from substance-free activities were expected to show greater relative benefit from the SFAS. Internal consistency of the substance-free and substance-related total scales in this sample at baseline and follow-ups was excellent (.91– .95).

Depression, Anxiety, and Stress scales (DASS)—The DASS is a set of three 7-item self-report scales designed to measure depression, anxiety, and stress. Participants use 4-point scales to rate the extent to which they have experienced each state over the past week. Students were given feedback on their mood if their scores were outside of the "normal range" on any of the subscales as specified in the DASS manual. The DASS is a reliable and valid measure of depression, anxiety and stress in college students (Mahmoud, Hall, & Staten, 2010). Because the SFAS attempts to increase goal directed behavior and it might therefore be especially effective with students who report depressive symptoms, we examined depression as a moderator of treatment outcomes and as a proximal intervention outcome. Internal consistency for the depression scale in this sample at baseline and follow-ups was good (.78 –.93).

Delay discounting and consideration of future consequences—We used two measures to assess the extent to which students are sensitive to immediate versus delayed outcomes or rewards. The Monetary Choice Questionnaire (MCQ; Kirby, Petry, & Bickel, 1999) is a measure of delayed reward discounting that presents participants with 27 choices between two hypothetical amounts of money. For each item, participants select a smaller, immediate reward or a larger, delayed reward (e.g., $40 today vs. $65 in 22 days?). Each item features varying amounts and delays, with each choice contributing to the estimate of the participant's overall discounting rate parameter (*k).* Delay discounting was calculated using the approach described by Kirby et al. (1999). Higher *k* values reflected a greater proportion of choices for the smaller immediate monetary amounts (i.e., a higher level of impulsiveness). Hypothetical money choices provide a reliable and valid estimate of discounting rates (MacKillop et al., 2010).

The Consideration of Future Consequences Scale (CFC; Strathman, Gleicher, Boniger, &Edwards, 1994) is a 12-item measure that aims to determine to what degree an individual is future vs. present-oriented (e.g., *" I consider how things might be in the future and try to influence those things with my day to day behavior.").* Responses are made with a Likert scale ranging from 1 (*extremely uncharacteristic*) to 5 (*extremely characteristic*). Items are summed to form a single scale that has demonstrated good internal consistency and test-retest reliability (Strathman et al., 1994) as well as convergent and construct validity (Adams & Nettle, 2009). Internal consistency at baseline and follow ups was good (.80 –.85).

Protective behavioral strategies—The Protective Behavioral Strategies Survey (PBSS; Martens et al., 2005) was used to measure the use of 15 protective behavioral strategies in relation to alcohol consumption. Participants were asked to indicate the degree to which they engaged in the listed behaviors "*when using alcohol or 'partying.*" Items were coded on a 5-point scale ranging from 1 (*never*) to 5 (*always*). This measure has good construct and convergent validity (Martens et al., 2005). Internal consistency at baseline and follow-ups was .80 –.88. Participants received feedback on protective behavioral strategies as part of the BMI, and it was also investigated as a proximal intervention outcome and mediator.

Time allocation and evening activity participation—Participants reported the number of hours they spent engaging in several activity categories during a typical week in the past month: studying, attending class, exercise, drinking/drug use, and extra-curricular activities. This was used to generate feedback on time allocation for the SFAS. Participants also rated the frequency of a variety of substance-free evening activities (attending movies, sporting events, watching TV, studying etc.). Activities were included as feedback on the SFAS as potential alternatives to drinking. Additionally, given the focus on the SFAS, the frequency of evening substance-free "*studying or doing school work*" was investigated as a proximal intervention outcome. Activities were rated using 5-point Likert scales 0 (*zero times in the past month*) to 4 (*daily or almost every day).*

Procedure

All procedures were approved by the University Institutional Review Board. During the first session participants completed study measures and a 50-minute alcohol-focused BMI with personalized feedback (BMI). This BMI session was modeled after the Brief Alcohol Screening and Intervention for College Students model (BASICS; Dimeff, Baer, Kivlahan, & Marlatt, 1999; Murphy, Dennhardt, Skidmore, Martens, & McDevitt-Murphy, 2010). Following the BMI, participants were randomized to either the SFAS or relaxation session. These sessions were administered one week after the BMI by the same clinician who administered the MI. Participants completed follow-up measures one month following the intervention (prior to the start of final exams) and in the following semester during the same week of the semester they completed the initial assessment (6-month follow-up). This allowed for an examination of drinking outcomes that was not influenced by the academic calendar (Del Boca Darkes, Greenbaum, & Goldman, 2004), which was particularly important given our hypothesis that changes in academic and other substance-free activities would contribute to reductions in drinking. Therefore, the next-semester or "6-month" follow-up actually occurred five months after the intervention for students enrolled in the fall semester and seven months after the intervention for students enrolled in the spring semester. Analyses were initially run separately for those enrolled in fall and spring but the results did not differ between the groups so they are combined below.

Clinician training and supervision—Clinicians were six graduate students in clinical psychology. All had prior experience conducting brief alcohol interventions with college students and had completed over 20 hours of training in MI that included readings, training DVDs, and role-plays. Clinicians completed similar training in the SFAS and received supervision (including review of session tapes) by study investigators J.G.M. and M.P.M.

BMI—This session included four major elements: (a) a discussion related to confidentiality, harm reduction, and the student's autonomy/responsibility to make decisions about the information provided in the session, (b) an alcohol use decisional balance exercise, (c) personalized alcohol-related feedback, and (d) summary, goal setting, and, reviewing protective behavioral strategies if the student indicated that he or she was interested. Elements included in the personalized feedback were: (a) a comparison of the student's perception of how much college students drink and actual student norms, (b) a comparison of the student's alcohol consumption vs. gender-specific national norms, (c) a chart displaying an estimate of the student's peak blood alcohol content (BAC) in the past month, (d) a list of alcohol-related problems that the student reported experiencing, (e) money spent on alcohol, and (f) calories consumed from alcoholic drinks. Clinicians utilized MI style and techniques to engage students in a discussion about the personalized feedback. If students were interested in changing their drinking, clinicians worked with them to set specific goals (see Murphy et al., 2010 for an evaluation of the alcohol BMI).

SFAS—The SFAS was a 50-minute individual counseling session designed to increase the salience of the student's academic and career goals, draw attention to the potentially negative relationship between substance use and goal accomplishment, and increase engagement in substance-free alternative activities. Study investigators developed this treatment using a sequential treatment development approach in which they drafted a manual and then modified it based on feedback from expert consultants in college drinking and behavioral economics, six focus groups with heavy drinking college students, and an open pilot trial ($N = 14$; Murphy et al., 2012). The SFAS was described to participants as the "College Adjustment Session". The session was conducted using an MI plus personalized feedback approach.

After a brief statement about the purpose and structure of the session, the clinician initiated an open ended discussion of the student's college and career goals. Students were encouraged to discuss the values they hold which may motivate them to pursue these goals. Students were then asked to talk about how alcohol use has interfered or may interfere with their ability to accomplish these goals. The next part of the session involved delivering information and personalized feedback. Students received information on (a) average income differences with a high school diploma versus a 4-year college degree, (b) college graduation rates (i.e., less than 50% of freshmen will graduate from college), (c) a graph depicting predicted future income differences based on college GPA (based on nationwide data indicating that a one point increase in GPA leads to approximately $3,980 more in salary every year; Orlean, 2009), and (d) a graph that depicted that average college GPA decreases as a function of time spent drinking, and increases with more time spent attending class and studying (based on unpublished data we collected from our university). They received personalized feedback on (a) the requirements (grades, graduate school) for the student's major and/or intended career (students who had not chosen a major or career were provided with general information about academic requirements for graduate school, and advice on how to choose a major), (b) a list of extracurricular and community activities tailored to the student's major and career goals, (c) a graph of the amount of time they allocate to various activities (class, studying, extra-curricular activities, exercise, and drinking/drug use), (d) for students reporting stress or depressive symptoms, information on these symptoms and possible adaptive coping responses (see Geisner, Neighbors, & Larimer, 2006), and (e) a list of substance-free recreational or leisure activities that the student reported currently participating in and enjoying as well as those that they reported they would enjoy but have not participated in recently.

The overall goal of the feedback was to enhance the value of delayed academic and career goals in part by specifying the specific academic and financial benefits associated with these outcomes. A second goal was to help students to make a connection between their current patterns of behavior (e.g., drinking, studying, and attending class) and the attainment of these delayed rewards. Another goal was to increase engagement in substance-free academic and leisure activities by providing personally tailored information on these activities and discussing barriers to engagement. Finally, for students who reported elevated stress or depression on the DASS, the feedback contained a section on depression and coping skills because depressive symptoms can interfere with productive goal-directed behavior and also increase the reinforcing value of alcohol (Rousseau, Irons, & Correia, 2011). After reviewing the feedback, students were given a goal setting worksheet and encouraged to set three academic or career goals and one personal goal. Finally, students received a day planner to assist with time management, and a list of tips from upperclassmen (generated in our focus groups) for succeeding in college.

The focus on identifying the student's values and any conflict between those values and current behavior is similar to the "values clarification exercises" included in Acceptance and

Commitment Therapy (ACT; Hayes et al., 2006) and with general principles of MI. Additionally, the focus on increasing goal directed academic and career related behaviors is consistent with Behavioral Activation (BA) and ACT approaches to treating depression (Lejuez et al., 2011). The SFAS is distinct from the later approaches, as well as from CBT/ Relapse Prevention approaches to treating addiction (which include modules on scheduling substance-free activities), in its use of MI style and the inclusion of personalized feedback intended to increase academic and other substance-free activities. Consistent with MI but not with BA, CBT, or ACT approaches, the SFAS was developed as a single-session intervention for use with individual who are not necessarily motivated to complete treatment or to change their behavior.

Relaxation training session—Relaxation training was chosen as a control condition because it is often part of substance abuse programs but has no significant effect on substance use (Klajner et al., 1984). The clinician began the session by presenting the student with the rationale that students often drink to relieve stress related to attending college. Students were encouraged to get comfortable and were given the option of sitting in a recliner. The clinician then led the student through a diaphragmatic breathing exercise, followed by a progressive muscle relaxation protocol (~30 minutes). At the end of the session, students were asked about their reaction to the relaxation techniques and were provided with relaxation training handouts.

Results

Data Analysis Plan

All variables were checked for outliers and deviations from normality prior to analysis. Outliers greater than 3.29 *SD*s above the mean ($p < .001$) were re-coded to one unit above or below the highest or lowest value that was not an outlier following the recommendations of Tabachnick and Fidell (2006). Square root or logarithmic transformations successfully corrected the significant skewness to the drinking variables including typical weekly drinking and heavy drinking episodes. Untransformed variables are presented in the tables and figures for interpretational clarity. Repeated measures ANOVAs were used to evaluate change in our primary drinking outcomes (drinks per week, heavy drinking, and alcohol related problems) across the three time points as a function of condition. We included gender as a between subjects factor because some studies have found that college women are more responsive to brief alcohol interventions than college men (Carey et al., 2007). Tests of moderation were conducted via the multiple regression procedures outlined by Aiken and West (1991). Frequency of heavy drinking was regressed on the main effects for intervention condition, baseline values of heavy drinking, the baseline moderator variable, and the interaction between intervention condition and the moderator, where a significant interaction indicates that the effects of the independent variables differ at levels of the moderator. Significant interactions were followed up with simple slopes analyses at high (i.e., one SD above the mean) and low (i.e., one SD below the mean) moderator values to determine the nature of the moderated effect. All continuous variables were mean-centered prior to analysis. We evaluated moderation separately for one and six-month outcomes. We also used repeated measures ANOVAs to evaluate change in proximal outcomes of the SFAS (substance-free reinforcement, delay discounting, future time orientation, and participation in evening academic activity). Finally, we used a bootstrapping approach to evaluate mediation if there was a treatment related change in an alcohol outcome and in a theoretically related mechanism. The bootstrapping procedure uses a random sample of 10,000 cases and bias-corrected confidence intervals.

Evaluation of Internal Validity

Twenty percent of the BMI sessions (n = 16), SFAS sessions (n = 8), and Relaxation sessions (n = 8) were randomly selected and reviewed by one of two masters-level clinicians who were not involved with the project but who were trained in motivational interviewing. At least one session for each clinician was reviewed using a brief intervention adherence protocol used in several previous BMI studies (Barnett et al., 2007; Murphy et al., 2010). Each of the components on the protocol was rated as a 1 "*Did it poorly or didn't do it but should have,*" 2 "*Meets Expectations*," or 3 "*Above Expectations*". A score of 2 or higher indicated that the intervention component was delivered in a manner that was consistent with the protocol in terms of both content and motivational interviewing style. For the 24 main components of the BMI protocol the mean rating was 1.89 (SD = .35, Mdn = 2.00), with 92% of the components rated as meeting or exceeding expectations. Competence on 10 specific MI skills (developing discrepancy, rolling with resistance, expressing empathy, etc.; Barnett et al., 2007) was rated using the same scale described above; the mean rating was 2.0 (SD = .19, Mdn = 2.00), with 93% of these items being rated as a 2 or 3. For the 23 main components of the SFAS protocol the average rating was 1.91 (SD = .31, Mdn = 2.00), with 91% of the components rated as meeting or exceeding expectations. Competence ratings for MI skills in the SFAS sessions averaged 1.96 (SD = .17, Mdn = 2.00), with 90% of these items being rated as a 2 or 3. The Relaxation session was rated for inclusion of the 12 key components of the session. The average rating was 2.03 (SD = .07, Mdn = 2.00), with 93% of the components rated as meeting or exceeding expectations. These ratings indicate that the clinicians consistently administered the intervention components in all three session types and adhered to an MI style in BMI and SFAS sessions.

Analysis of Drinking Outcomes—There were no significant group differences on any of the drinking variables at baseline. All 82 randomized participants completed both intervention sessions (Figure 1). One participant did not complete the one-month follow-up (N = 81, 99% follow-up rate) and 11 participants did not complete the six-month follow-up (N = 71, 87% follow-up rate). Follow-up rates did not differ by condition and there were no demographic or baseline drinking differences between completers and non-completers. Table 1 shows baseline, one-month, and six-month descriptive data on all drinking measures, including the pre-post (within group) effect sizes. The primary alcohol outcome analyses presented below include only those participants who completed the one and 6-month follow-ups (N = 71).

Alcohol consumption and problems—A series of two time by group by gender (3 x 2 x 2) repeated-measures ANOVAs revealed significant effects for time on typical drinks per week [F(2, 130) = 23.61, p < .001] and past-month number of heavy drinking episodes [F(2, 132) = 26.77, p < .001]. Participants in both conditions showed similar moderate-size reductions in drinks per week that were larger at the one-month follow-up and dissipated slightly by the six-month follow-up (Table 1). Participants assigned to BMI + SFAS showed larger effect size reductions in heavy drinking than participants in BMI + Relaxation at both the one-month (d_{ws} =. 73 & .52, respectively) and the six-month follow-up (d_{ws} =.82 & .49, respectively). There were no significant time by condition, time by gender, or three-way interactions (all ps >.10)

A repeated-measures ANOVA on reports of alcohol-related problems revealed a significant time by group interaction, F(2, 118) = 4.33, p = .015, (η_p^2 = .07). There were no significant gender by time or three-way interactions. As can be seen in Figure 2 and Table 1, participants in the BMI+SFAS condition showed a large effect size reductions in alcohol problems at one-month (d_w = .98) and largely maintained that reduction at the six-month

follow- up (d_w = .71). Participants in the BMI + Relaxation condition showed no change in problems at one-month and a small effect size change at six-months (d_w = .26).[1]

Moderation Analysis—We tested the hypotheses that the BMI+SFAS intervention would be more effective than BMI + Relaxation for participants with lower baseline levels of substance-free reinforcement and future time orientation, and with higher baseline levels of delay discounting and depression. To limit the number of analyses, we examined moderation only for the dependent variable frequency of heavy drinking, which was the primary direct target (in addition to alcohol problems) of this harm reduction intervention. Across conditions, lower baseline substance-free reinforcement was associated with greater heavy drinking, in a model that controlled for baseline heavy drinking, at the one-month (but not six-month) follow-up (β = −.20, p = .022). Baseline substance-free reinforcement significantly moderated the effect of treatment condition on one-month (but not six-month) heavy drinking (β = .61, p = .022). A simple slopes analysis indicated that BMI + SFAS was associated with fewer follow-up heavy drinking episodes than BMI + Relaxation among participants with lower levels of substance-free reinforcement at baseline (β = −.31, p = .01). There was no difference between conditions for participants with higher levels of substance -free reinforcement at baseline (β = .08, p = .49) (see Figure 3). Higher baseline consideration of future consequences scores predicted lower six-month (but not one-month) heavy drinking (β = −.28, p = .008) but moderation results were not significant. Delay discounting was not associated with outcomes as a predictor or moderator (all ps > .10). Baseline depression was not related to overall treatment outcome, but significantly moderated the effect of treatment on six-month (but not one-month) heavy drinking episodes (β = −.73, p = .049). A simple slopes analysis indicated that BMI + SFAS was associated with fewer follow-up heavy drinking episodes than BMI + Relaxation among participants with higher levels of depression at baseline (β = −.40, p = .016), but there was no difference between conditions for participants with lower depression scores (β = .09, p = .59) (see Figure 3).

Evaluation of Proximal Intervention Outcomes and Mediation

Change in proximal intervention outcomes—We first used repeated-measures ANOVAs to evaluate treatment-related change in the proposed mediator from baseline to one-month follow-up (Table 2). There was a significant effect for time on depression scores, $F(1, 73) = 14.38$, $p < .001$, but no condition by time interaction. Across both conditions, participants reported reductions in depression. There was a trend level condition by time interaction for protective behavioral strategies ($F(1, 72) = 3.76$, p = .056), with greater increases in PBS in the BMI + SFAS condition. There were no significant changes in total substance-free reinforcement as measured by the ARSS. There was a significant treatment by time interaction on frequency of evening studying, $F(1, 73) = 4.9$, p = .03. Participants in the BMI + SFAS condition showed nearly identical levels of evening studying from baseline to follow-up, whereas participants in the BMI + Relaxation condition decreased their frequency of evening studying (Table 2). There was a non-significant trend-level condition by time interaction for consideration of future consequences scores, $F(1, 74) = 3.07$, p = .078, with a greater increase among BMI + SFAS participants. There were no significant changes in delay discounting.

[1]We also conducted supplemental repeated measures ANOVAs to examine change in alcohol use and problems from baseline to the one-month follow-up (i.e., six-month outcomes were excluded). This allowed us to examine short-term intervention outcomes for 81 out of 82 participants (99%) who were randomized to an intervention (an intent to treat analysis). These outcomes were functionally identical to the three time point repeated measures analyses described above both in terms of statistical significance and effect size.

Mediation—Given the significant treatment effect on alcohol problems, and trend level effects on the related proximal mechanisms of consideration of future consequences and protective behavioral strategies, we conducted tests of mediation to determine if the effect of BMI + SFAS on alcohol problems was accounted for by increases in these variables. Although there was a treatment effect on frequency of evening studying, we did not investigate this construct as a putative mediator as there is not a theoretical rationale linking this variable to reduced alcohol problems. In the model examining mediation by protective behavioral strategies, treatment condition was associated with baseline to one-month protective behavioral strategies change scores ($\beta = -.22$, $p = .05$), changes in protective behavioral strategies were associated with alcohol-related problems ($\beta = .25$, $p = .03$), and condition was directly associated with alcohol-related problems ($\beta = -.23$, $p = .04$). The bootstrapping analyses indicated that the indirect effect of treatment condition on alcohol-related problems was also statistically significant, as the 95% CI did not contain zero (−.004, −.154). These findings indicate that baseline to one-month changes in protective behavioral strategies use partially mediated the relationship between treatment condition and alcohol-related problems. In the model examining mediation by consideration of future consequences, changes in consideration of future consequences was not associated with alcohol problems ($\beta = .11$, $p = .34$). Therefore, we do not have an important precondition for mediation (i.e., the MV-DV relationship).

Discussion

Brief motivational interventions (BMIs) for alcohol abuse are among the most cost-effective preventive care measures (Maciosek, Coffield, Edwards, Flottenmesch, & Solberg, 2009), and the development of innovative and theoretically based methods for improving BMIs is an important research and public health priority. In comparison to an equivalent length (two session) and modality (individual, counselor administered) control condition that included a standard alcohol BMI session and a relaxation training (RT) session, BMI + SFAS was associated with significantly greater reductions in alcohol problems and, among students with greater depression and lower substance-free reinforcement, greater reductions in heavy drinking. To our knowledge, this is the first controlled study to demonstrate that a brief, individual supplement to traditional BMIs can improve outcomes. The BMI + SFAS resulted in greater reductions in alcohol problems in part because students increased their use of protective behavioral strategies (PBS). Because participants in both conditions received information and feedback on PBS (during the BMI), the increase in PBS may have been motivated by a desire to minimize the impact of drinking on college and career goals (e.g., avoiding arrests, injuries, hangovers) that became more salient following the SFAS.

The present results suggest that the SFAS may enhance the effects of BMIs on heavy drinking for students with elevated depressive symptoms or with lower levels of substance-free reinforcement, two factors that have previously been associated with poor response to BMIs (Geisner et al., 2007; Murphy et al., 2005). It is interesting that participants' levels of depression and substance-free reinforcement were not significantly correlated ($r = .09$), indicating that, despite demonstrating similar positive benefit from the SFAS, these risk factors appear to be distinct in this population. The positive response to the SFAS among depressed students may be attributable to the inclusion of feedback on coping with depressive symptoms in the SFAS (Geisner et al., 2006), or to the focus on increasing goal directed academic and career related behaviors (Hayes et al., 2006; Lejuez et al., 2011). Participants in the BMI + Relaxation condition with depression or low substance-free reinforcement may have been less likely to reduce their heavy drinking due to a perceived lack of enjoyable alternatives to drinking.

The fact that students with fewer alternatives to drinking benefitted from the SFAS is encouraging and suggests that the risk associated with deficiencies in substance-free reinforcement can be partially mitigated by directly targeting this mechanism in the context of a brief intervention (Correia et al., 2005). Although the SFAS did not directly increase overall levels of substance-free reinforcement, it was associated with more frequent evening studying and a trend-level increase in consideration of future consequences scores. It is possible that students avoided heavy drinking (and alcohol problems) in order to minimize the impact of drinking on the academic goals that they developed in the SFAS session. Thus, the session may have increased the salience of these delayed rewards and the perception that alcohol problems could impede progress towards these goals.

Consistent with previous behavioral economic research (MacKillop & Kahler, 2009; Murphy et al., 2005; Tucker et al., 2009), across all conditions, reductions in drinking were more likely among individuals who at baseline had more enjoyable substance-free alternatives to drinking and a greater valuation of future outcomes. This suggests that these variables may function as meaningful protective factors even among heavy drinkers. However, these protective factors each only predicted outcomes at one of the two follow-ups, and a standard hypothetical money choice measure of delay discounting did not predict change in drinking or response to intervention. It is possible that this pattern of mixed support for behavioral economic mechanisms of change is due to limitations in the measurement approach, or limited power to detect small effects - especially in light of the fact that all participants completed an alcohol BMI that may have impacted similar mechanisms of change.

Strengths and Limitations

Strengths of this study include the use of a randomized controlled design to evaluate a novel supplement to standard BMIs that is based on a coherent body of basic research on reinforcement and decision making. The study also included an evaluation of internal validity, along with two follow-up assessments that examined changes in drinking and behavioral economic variables, as well as mediation and moderation effects. Limitations of this study include the fact that the relatively small sample size and brief follow-up period did not allow for a detailed assessment of long-term change in drinking and substance-free activities. Additionally, session ratings indicated that most all sessions were administered competently, but very few sessions were rated as above expectations. It is possible that additional training or supervision would have resulted in greater MI adherence and better outcomes.

Implications and Future Directions

Our findings are consistent with behavioral economic theory and suggest that reductions in heavy drinking and alcohol problems may be facilitated by an intervention that highlights the long term academic, career, and financial outcomes associated with current patterns of behavioral allocation to drinking and substance-free behaviors. The SFAS may be especially effective for reducing alcohol problems by motivating students to employ more protective behavioral strategies. Students with depressive symptoms and lower levels of substance-free reinforcement may experience perceived or actual constraints on access to substance-free reinforcers and may thus benefit from the explicit focus on increasing both enjoyable leisure behaviors and goal directed behaviors that are consistent with long-term goals. Although further research with larger samples and longer follow-up periods is needed prior to dissemination of this approach, the fact that the goals of the SFAS include increasing engagement in constructive aspects of college life may make it an appealing approach for adoption at many colleges and universities. The current study suggests that the SFAS might benefit young adult drinkers who are transitioning to college. Future research should attempt

to modify the SFAS for other populations that might benefit from a brief intervention approach that attempts to increase engagement in constructive alternatives to drinking, including college students in their 2nd –4th years (including students ages 21 and over who may have greater relative access to substance-related rewards), young adults transitioning to the workforce, military veterans, older adults transitioning to retirement, or the unemployed. Future research should also examine the timing and frequency of the SFAS (e.g., delivering the SFAS immediately after the BMI or providing booster contact). Finally, although our results cannot be directly applied to campus wide prevention programs that attempt to increase alternatives to drinking, our results do lend further support to a wider body of basic research and theory linking alternative reinforcers to lower substance use and thus provide indirect support for such programs.

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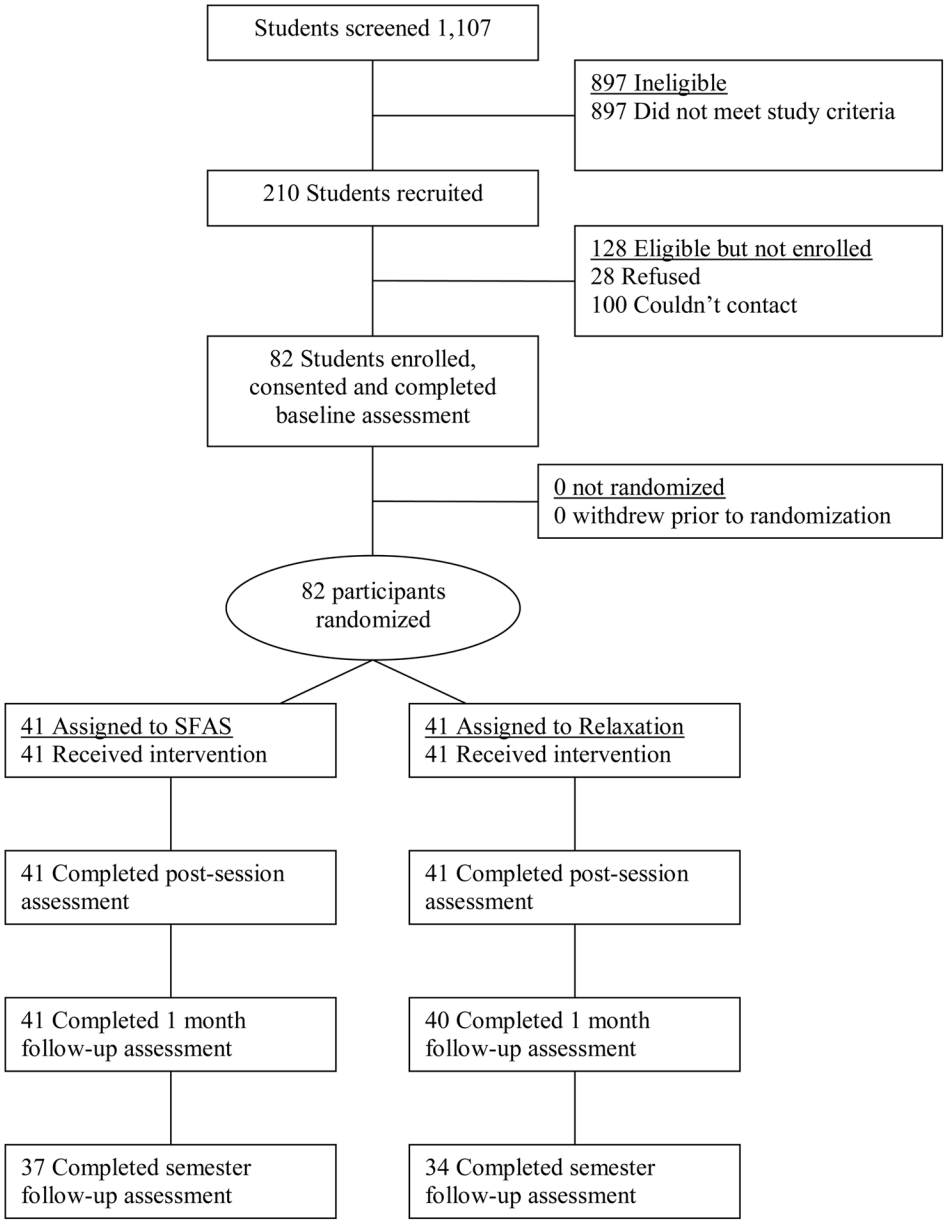

Figure 1.
Flow chart illustrating recruitment, intervention assignment, and follow-up assessment.

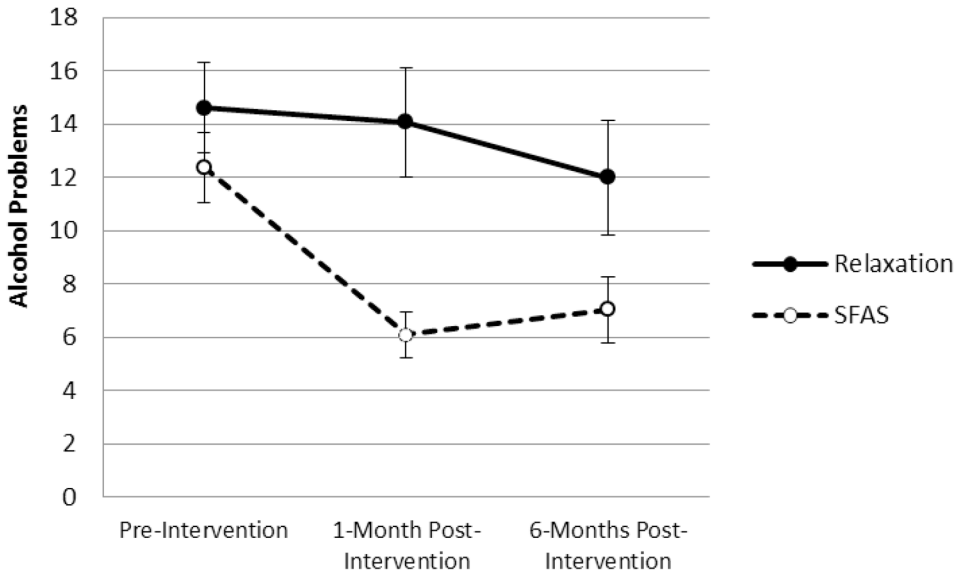

Figure 2.
Changes in past-month number of alcohol problems from baseline to follow-up by intervention condition. Error bars reflect +/− 1 standard error of the mean.

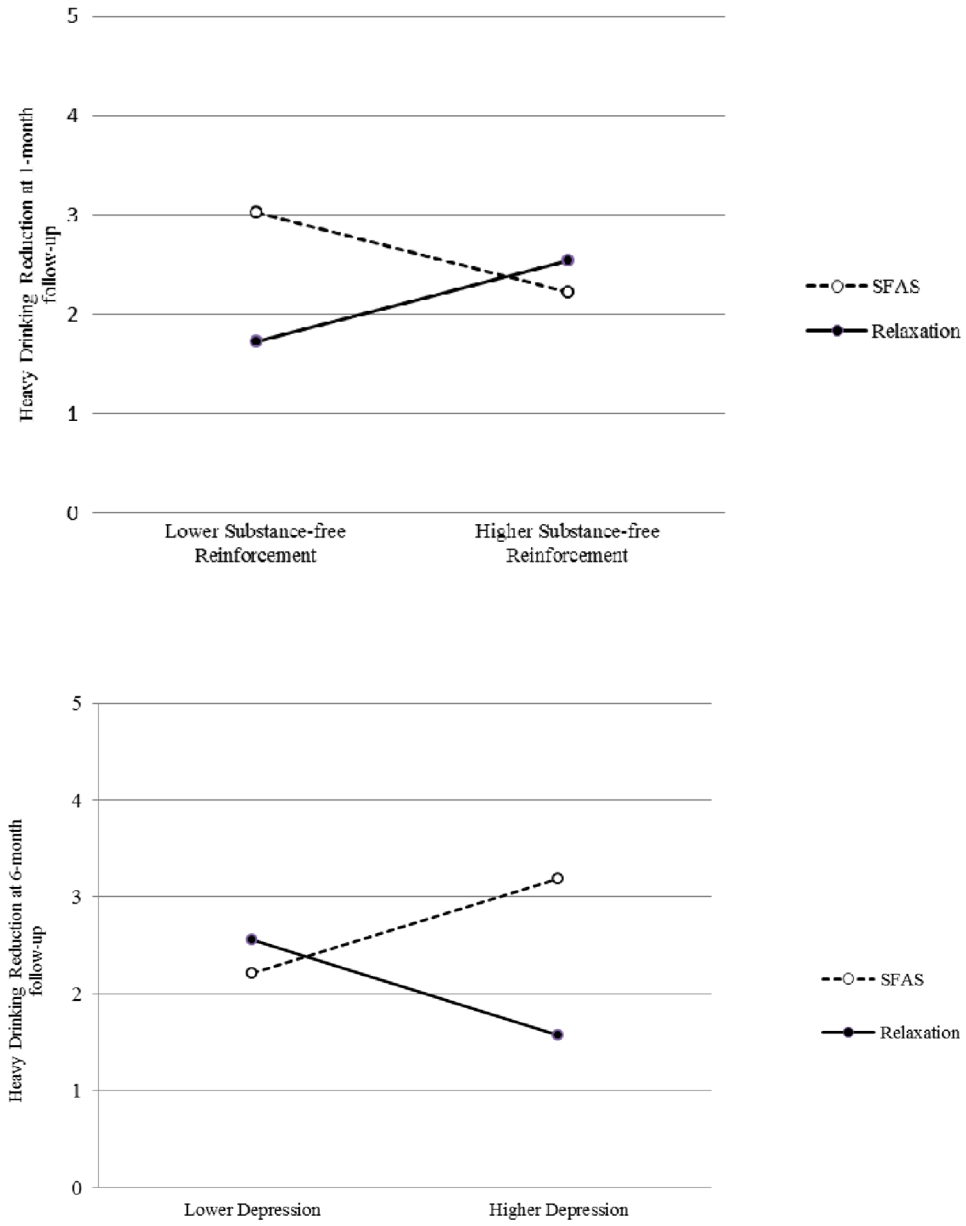

Figure 3.

The upper panel shows estimated heavy drinking reductions by condition at the one-month follow-up for students with high (+ 1 SD) versus low (− 1 SD) levels of substance-free reinforcement. Students with low substance-free reinforcement assigned to the SFAS reported significantly less heavy drinking at the one-month follow-up. The lower panel shows estimated heavy drinking reductions by condition for students with high (+ 1 SD) versus low (− 1 SD) levels of depression at the six-month follow-up. Students with elevated depression assigned to the SFAS reported significantly less heavy drinking at the six-month follow-up. Participants reported an average of 6.01 (SD = 4.13) heavy drinking episodes at baseline and there were no significant differences as a function of substance-free reinforcement or depression level.

Table 1

Pre-Post Means (SD) and Effect Sizes for Drinking Outcomes

Factor	Baseline	1-month follow-up	6-month follow-up	*Within-groups effect size (d)* (1-month)	*Within-groups effect size (d)* (6-month)
Typical Drinks Per Week					
SFAS	15.08 (9.12)	9.32 (6.75)	10.92 (9.27)	.73	.45
Relaxation	18.92 (12.40)	11.55 (9.64)	14.13 (12.97)	.67	.38
Heavy Drinking					
SFAS	5.45 (3.62)	3.03 (3.04)	2.76 (2.94)	.73	.82
Relaxation	6.58 (4.63)	4.32 (4.05)	4.38 (4.35)	.52	.49
Alcohol-related Consequences					
SFAS	12.37 (7.77)	6.09 (5.11)	7.03 (7.25)	.98	.71
Relaxation	14.61 (9.02)	14.07 (10.87)	12.00 (11.41)	.05	.26

Note: Sample sizes were as follows for SFAS and Relaxation respectively: Drinks per week: *n*s = 37, 32; Heavy Drinking: *n*s = 37, 33; Alcohol consequences: *n*s = 35, 28. Analyses of alcohol consequences included a smaller sample size due to the fact that several participants completed a brief follow-up interview over the phone that did not include the measure of alcohol problems. All values reflect past-month estimates (typical drinks per week, number of heavy drinking episodes, and number of alcohol-related consequences).

Table 2

Pre-Post Means (SD) and Effect Sizes for Variables Associated with SFAS

Variable	SFAS Baseline	SFAS 1-month follow-up	Within-groups effect size *(d)*	Relaxation Baseline	Relaxation 1-month follow-up	Within-groups effect size *(d)*
Depression	7.76 (8.45)	4.84 (8.40)	.35	6.97 (6.19)	5.77 (6.86)	.19
Protective Behaviors	53.32 (12.53)	59.76 (14.18)	.48	52.73 (12.42)	54.70 (14.81)	.15
Substance-free Reinforcement	6.11 (2.08)	6.12 (2.11)	.01	5.93 (2.04)	6.05 (2.51)	.05
Evening Studying	3.32 (.74)	3.29 (.93)	−.04	2.89 (.99)	2.46 (1.07)	−.42
Consideration of Future Consequences	39.87 (7.43)	41.36 (8.24)	.19	40.00 (6.51)	39.15 (6.52)	−.13
Delayed Discounting	.040 (.050)	.036 (.040)	.08	.043 (.047)	.042 (.037)	.02

Note: Sample sizes were as follows for SFAS and Relaxation respectively: Substance-free Reinforcement: *n*s = 37, 38; Depression: *n*s = 38, 39; Delay Discounting: *n*s = 39, 39; Consideration of Future Consequences: *n*s = 39, 39; Protective behaviors: *n*s = 37,37; Evening studying: *n*s = 38, 37.