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Predictors of Change in College Freshmen and Sophomore Cognitions of Alcohol Expectancies

David Lee Villegas
University of Rhode Island, david_villegas@my.uri.edu

PREDICTORS OF CHANGE IN COLLEGE FRESHMEN AND SOPHOMORE COGNITIONS OF ALCOHOL EXPECTANCIES

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DAVID LEE VILLEGAS

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DAVID LEE VILLEGAS

APPROVED:

Dissertation Committee:

Major Professor Robert G. Laforge

Gary Stoner

Stephen L. Kogut

Nasser H. Zawia

DEAN OF THE GRADUATE SCHOOL

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ABSTRACT

This dissertation examined predictors of change in college freshmen and sophomore cognitions of alcohol expectancies through secondary analyses of data collected in a randomized brief motivational interview (BMI) intervention for at-risk college drinkers (N=1067). Positive and negative alcohol expectancies were assessed at 6 time points over a 2 year period. Information on the selected predictors, which include demographic, peer and family influence, alcohol use and problem, and other drug use variables, was collected at baseline. Change in alcohol expectancies over time was evaluated using linear mixed effects regression and hierarchical modeling procedures. Results indicated that positive and negative alcohol expectancies developed differently, yet aligned with established trends in alcohol use within this population. Positive expectancies were observed to increase over the first 6 months of the study which coincides with a time period associated with elevated college drinking; entry into college or the start of the academic year. During this same period, negative expectancies decreased significantly. Further, in addition to randomly-assigned treatment condition, change in positive alcohol expectancies was moderated by race and alcohol-related problems. Non-Whites and students experiencing a low level of problems at baseline maintained healthier (lower levels) positive alcohol expectancies throughout the study. Treatment effects on change in positive alcohol expectancies were moderated by gender, class year and binge frequency. Across all levels of predictors, students that did not receive the intervention exhibited greater gains in positive alcohol expectancies. Positive effects did not extend beyond 1 year

follow-up. Negative alcohol expectancies were moderated by treatment, gender, cigarette and marijuana use. Students that received the intervention exhibited greater reductions in negative alcohol expectancies from baseline to 6-month follow-up. Males and females exhibited similar reductions in negative expectancies over the course of the study with little evidence indicating that mean differences at each time point were stastistically significant. Finally, students that reported frequent use of cigarettes and marijuana at baseline maintainted the lowest levels of negative alcohol expectancies over time. The effects of treatment were not conditional on any predictors. These findings support the BMI employed in this study as an effective strategy for facilitating healthier cognitions related to alcohol use. Future studies examining the longitudinal mediation effects of alcohol expectancies on alcohol use by college students could extend current findings. Motivational interventions are only effective if they produce changes in the way people think about problem behavior that precipitates actual behavior change.

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CHAPTER 1

INTRODUCTION AND REVIEW OF THE LITERATURE

I. Background

Alcohol misuse among U.S. college students is a public health problem associated with many negative consequences (Nelson, Naimi, Brewer & Wechsler, 2005; Wechsler & Nelson, 2008; Wechsler, Lee & Lee, 2000; Hingson, Heeren, Winter & Wechsler, 2005). High risk drinking behaviors are most prevalent during the freshmen and sophomore years, tending to diminish gradually in the later college years (Wechsler, Lee, Kuo, Seibring, Nelson & Lee, 2002; Muthen & Muthen, 2000; Kilty, 1990; Schulenberg, O'Malley, Bachman & Johnston, 1996; Schulenbert & Maggs, 2002; Weitzman, Nelson & Wechsler, 2003). Epidemiologic research has called attention to the high rates of abusive and risky drinking behaviors, such as binge drinking, and to the wide range of related negative personal, social and health consequences (Nelson, Naimi, Brewer & Wechsler, 2005; Wechsler & Nelson, 2008; Wechsler, Lee, Kuo, Seibring, Nelson & Lee, 2002; Wechsler, Moeykens, Davenport, Castillo & Hansen, 1995; Hingson, Heeren, Winger & Wechsler, 2005; U.S. Department of Health and Human Services, 2011). Research to understand the role of psychological, cognitive, and behavioral factors affecting high risk drinking is critical for the development of effective intervention and prevention strategies to reduce alcohol risk-taking in college.

Reviews of the available research on college alcohol interventions found that multi-component brief motivational feedback interventions (BMI) are among the most effective and promising methods known to reduce college student alcohol use and alcohol problems (McNally, Palfai & Kahler, 2005; Baer, Marlatt, Kivlahan, Fromme, Larimer & Williams, 1992; Borsari & Carey, 2000; Dunn, Deroo & Rivara, 2001; Larimer et al., 2001; Murphy). Typically, the BMI consists of several components that are each thought to involve potentially important mechanisms that can help to change student thoughts, beliefs and behaviors related to high risk drinking. Brief motivational feedback interventions for college students employ one or more of the following components: personalized feedback on drinking related behaviors, attitudes and beliefs; feedback about peer drinking and social norms; educational information on alcohol use and levels of impairment; low risk drinking strategies; and feedback to aid self-evaluation of the perceived benefits and risks of high risk drinking behaviors (Rollnick & Miller, 1995; Miller & Rollnick, 2003; Dimeff, 1999; Murphy et al., 2001).

While there is some evidence for the efficacy of college alcohol BMI interventions, largely from a few well designed studies, the majority of findings are inconsistent in many respects, including on the size or duration of observed intervention effects and sampling, and few studies are directly comparable because of little consistency in standardization and implementation of the intervention components (Borsari & Carey, 2000; Larimer et al., 2001; Mun, White & Morgan, 2009; Doumas, McKinley & Boo, 2008; Larimer & Cronce, 2002; Thush et al., 2007; Carey, Carey, Maisto & Henson, 2006; Borsari & Carey, 2005; Wood, Capone, Laforge, Erickson & Brand, 2007; Fromme & Corbin, 2004). Not surprisingly, the need to improve the effectiveness of brief interventions for alcohol harm reduction is an important motivation for some recent efforts to study the effectiveness of BMI components such as feedback on student cognitions of the positive and negative effects of alcohol (Collins & Carey, 2005; LaBrie, Pederson, Earleywine & Olsen, 2006; Carey, Carey, Maisto & Henson, 2006).

Research has shown that beliefs about the expected outcomes or effects of alcohol use are related to high risk alcohol behaviors (Webb & Sheeran, 2006; Wood, Read, Palfai & Stevenson, 2001; Scheier & Botvin, 1997; Borsari, Murphy & Barnatt, 2007), which call attention to the need to study whether change in expectancy beliefs may be an effective mechanism of alcohol harm reduction intervention. Outcome Expectancy Theory[1], which stems from Bandura's Social Cognitive Theory (SCT; Bandura, 1986), holds that people are motivated to engage or refrain from behaviors, such as high risk drinking, according to what they believe the expected outcome will be (Goldman, Brown & Christiansen, 1987; Chassin, Presson, Sherman, Corty & Olshavsky 1984; Christiansen, Smith, Roehling & Goldman, 1989; Agrawal, Dick, Bucholz, Madden, Cooper & Sher, 2008). Similarly, the theory of rational decision posits that a potentially effective mechanism to promote the adoption of a desired health behavior -- such as minimizing high risk drinking -- is to shift the balance between the pros (positive expectancies) and the cons (negative expectancies) in favor of adoption of low-risk, and away from engaging in high-risk, drinking behaviors (Mann, 1972; Janis & Mann, 1977; Prochaska, DiClemente, Velicer & Rossi, 1992; Prochaska, DiClemente & Norcross, 1992; Prochaska et al., 1994; Prochaska &

[1] When applied to alcohol use Outcome Expectancy Theory is known as Alcohol Expectancy Theory.

Velicer, 1997; DiClemente & Prochaska, 1998). Both outcome expectancies and the theory of rational decision making relate to Cox and Klinger's (1990) dimensional perspective of drinking motives which can be classified in terms of valence (positive or negative) and source (internal or external) (O'Connor & Colder, 2005). In fact, Noar, Laforge, Maddock and Wood (2003) compared these constructs, their associations and ability to predict alcohol use and problems in a college student sample and found significant positive correlations between positive expectancies and pros and negative expectancies and cons. In addition, the pros subscale had a strong positive association with alcohol problems and cons correlated negatively with alcohol use.

In the present study alcohol expectancies were measured with the Decisional Balance for Alcohol Use (Laforge, Krebs, Kypri & Maddock, 2005). Positive and negative alcohol expectancies are more commonly measured with longer instruments that carry a higher response burden on participants in repeated measures studies. A prime example is the Comprehensive Effects of Alcohol Questionnaire (CEOA; Fromme, Stroot, & Kaplan, 1993) which contains thirty-eight items that measure expected effects of alcohol and the subjective evaluation of those effects. The CEOA is made up of seven subscales that measure positive expectancy factors of sociability (8 items), tension reduction (3 items), liquid courage (5 items), and sexuality (4 items), and negative expectancy factors of cognitive and behavioral impariment (9 items), risks and aggression (5 items), and self-perception (4 items). Subjects that are administered the CEOA are provided with the item stem "If I were under the influence from drinking….." (e.g., "I would be outgoing" [sociability]; "I would act aggressively" [risk and aggression]) and asked to rate the degree to which they agree with each item on a 4-point Likert scale (1=Disagree, 2=Slightly disagree, 3=Slightly agree, 4=Agree).

Combined, the Pros and Cons of Alcohol Consumption, subscales within the Decisional Balance for Alcohol Use, are twelve items that measure perceived gains (6 items) and losses (6 items) associated with alcohol use. These orthogonal subscales are described in greater detail in Chapter 2. Participants that are administered the Pros and Cons of Alcohol Consumption are asked to rate "how important" specific effects of alcohol use (e.g., "I feel happier when I drink" [pros]; "Drinking could get me in trouble with the law" [cons]) are when making decisions about how much to drink. Participants are required to respond on a 5-point Likert scale (1=Not at all important, 2=Not very important, 3=Somewhat important, 4=Very important, 5=Extremely important). This measure is very similar to the one used by Noar, Laforge, Maddock and Wood (2003) in their comparison study of alcohol expectancies, measured with the CEOA, and decisional balance. The Pros and Cons subscales employed in that study each had two additional items.

II. Statement of the Problem

Despite extensive research on the association between alcohol expectancies and college student drinking outcomes (Brown, 1985; Stacy, Widaman & Marlatt, 1990; Jones, Corbin & Fromme, 2001; Goldman, Brown, Christiansen & Smith, 1991; Goldman, Del Boca & Darkes, 1999; Sher, Wood & Raskin, 1996), there have been very few comprehensive studies on how cognitions or beliefs about alcohol effects differ across student populations and little is known about how changes in the belief profile about the expected effects of alcohol use are related to changes in alcohol use and risk-taking over time. Regarding the former, studies investigating moderators of alcohol expectancies have examined the effects of gender (Read, Wood, Lejuez, Palfai & Slack, 2004; Capone & Wood, 2009; Foster, Young, Bryan, Steers, Yeung & Prokhorov, 2014; Kenney & LaBrie, 2013), parent influence or family history of alcoholism (Turrisi, Wiersma & Hughes, 2000; Sher et al., 1996) and drinking levels (Dunn & Goldman, 1998; 2000; Dunn & Yniguez, 1999). Longitudinal studies of the relation of change in alcohol expectancies and drinking outcomes are more limited and have employed assessment timelines that may not be conducive to the examination of naturalistic change in expectancies over time (Sher, Wood, Wood & Raskin, 1996; Patrick, Cronce, Fairlie, Atkins & Lee, In press).

This dissertation will examine one aspect of the problem using longitudinal data from the College-Based Alcohol Risk Reduction study which was funded by the National Institute for Alcohol Abuse and Alcoholism (NIAAA; 1 R01 AA12068-01). The CBARR study is a two year trial of a brief alcohol harm reduction intervention that recruited participants from the general population of freshmen and sophomore students at a large, Northeastern university (University of Rhode Island). To be eligible for the study, students must have: (a) indicated past drinking behavior or the intent to drink in the future, (b) not screened positive for alcohol abuse or dependence and (c) never received treatment for alcohol use. Eligible students were randomized to assessment-matched and treatment conditions. The multi-component BMI delivered to the treatment group involved three personalized feedback reports designed to reduce the positive expectancies (pros) of heavy drinking over the first six months of the study. All participants were assessed at six time points over two years with a battery of behavioral, cognitive and affect measures (Note: More detail on the CBARR study design, participants and treatment is provided in Chapter 2).

This dissertation will examine baseline predictors of change in alcohol expectancies over the two year period and will evaluate whether the growth in positive and negative alcohol expectancies over these two years is moderated by the BMI intervention (treatment) and/or by other factors known to be related to expectancy beliefs, alcohol use and experience of alcohol-related problems by college students. These factors include gender, race, class year, parent alcoholism, peer influence, Greek status, binge frequency, alcohol-related problems and cigarette and marijuana use. Additional analyses were completed to determine if these predictors moderated the effects of treatment on change in alcohol expectancies over time. The relevant literature are described in greater detail in the following section.

III. Review of the Literature

III.A. Brief Motivational Interviewing: An Effective Approach to Reducing High Risk Drinking by College Students

U.S. college students are at an increased risk for heavy alcohol use and related problems (Nelson, Naimi, Brewer & Wechsler, 2005; Wechsler & Nelson, 2008; Wechsler, Lee & Lee, 2000; Hingson, Heeren, Winter & Wechsler, 2005). This has been established in national surveys on alcohol use by college students and non-college attending peers (O'Malley, 2002; Johnston, O'Malley & Bachman, 1996). Reports indicate that 40% of college students (vs. 34% for non-college peers) engage in binge drinking (5/4 or more drinks on a single occasion for men/women; Dejong, 2002) which is a level associated with increased cognitive and psychomotor deficits

(O'Malley, 2002; Breitmeier, Seelan-Schulze, Hecker & Schneider, 2007). Further, more than 30% of college students are estimated to meet diagnoses of alcohol abuse (Knight, Wechsler, Kuo, Seibring, Weitzman & Schuckit, 2002).

Problems experienced by college students as a result of alcohol use range in severity, from minor issues with academics (e.g., missing class, poor test performance) to trouble with the law (Wechsler & Nelson, 2008; Powell, Williams & Wechsler, 2004; Presley, Meilman & Lylerla, 1993; Berkowitz & Perkins, 1986). Vandalism, assault, domestic disputes and rape are all issues that are more common at institutions with high binge drinking rates (Powell, Williams & Wechsler, 2004). More alarming is the incidence of alcohol-related unintentional injury and death. Population weighted estimates provide that college students make up 65% of all alcohol-related traffic fatalities for adults ages 18-24 (Hingson, Zha & Weitzman, 2009). This is not surprising considering one in ten college students report driving after a binge episode, and 23% report riding in a vehicle operated by an alcohol impaired driver (Wechsler & Nelson, 2008; Wechsler, Lee, Nelson & Lee, 2003).

The prevalence of high risk drinking on college campuses and potential consequences has caught the attention of state offices, college administrators and researchers alike, leading to environmental policy changes at the national and college levels. Examples include the passing of the National Minimum Drinking Age Act by Congress in 1988 and campus-wide education and social norms campaigns (Hingson, 2010; Larimer & Cronce, 2007; Larimer & Cronce, 2002; Liu, Seibring & Wechsler, 2004). Environmental policy changes have significantly reduced the incidence of drunk driving and traffic deaths among young adults (Hingson, 2010). College initiatives have been less impactful (Werch et al., 2000; Werch, Pappas & Castellon-Vogel, 1996).

Research on prevention and intervention strategies to reduce high risk drinking and associated problems experienced by college students increased in the 1990s leading to the development of evidence-based, multi-component brief motivational interventions (BMIs) (Annis et al., 1996; Baer, Kivlahan & Blume, 2001; Dimeff, Baer, Kivlahan & Marlatt, 1999). These interventions commonly use cognitive-behavioral skills training, harm-reduction principles, personalized feedback on drinking norms and alcohol expectancies, and Motivational Interviewing (MI; Miller & Rollnick, 2002) to motivate students the change problem behavior (Murphy et al., 2001; Dimeff, Baer, Kivlahan & Marlatt, 1999).

Interventions such as these have demonstrated positive effects on alcohol use and/or consequences at varying levels of intensity (multiple vs. single sessions) (Larimer and Cronce, 2002). Participants that receive treatment report significant reductions in alcohol consumption and problems relative to peers assigned to control conditions that extend as far as two-year follow-up (Garvin, Alcorn & Faulkner, 1990; Kivlahan, Marlatt, Fromme, Coppel & Williams, 1990). Though there are null findings (Collins & Carey, 2005), much of the evidence indicates that BMIs offer an effective alternative to widely used, educational approaches (Murphy et al., 2001; Borsari & Carey, 2005; Borsari & Carey, 2000; Larimer & Cronce, 2002). The demonstrated effectiveness of BMIs over educational approaches in decreasing substance-related negative consequences, reducing substance use and promoting treatment engagement, especially for subjects at higher risk, has led some researchers to conclude that students know the risks of heavy drinking yet are not motivated to change (Tevyaw & Monti, 2004; Borsari & Carey, 2005; 2000). That is, BMIs are more effective because they target factors that influence student motivation to change and educational approaches do not.

III.B. Motivating Students to Reduce High Risk Drinking through Feedback on Alcohol Expectancies

A common component of BMI interventions designed to motivate students to change high risk drinking behavior is that of individualized feedback on perceived drinking norms, alcohol expectancies and decisional balance. Support for feedback on perceived drinking norms as a mechanism for behavior change stems from findings that students have the tendency to overestimate the quantity and frequency of alcohol consumed by their peers and that this overestimation contributes to personal drinking behavior (Haines & Spear, 1996; Perkins & Berkowitz, 1986). It has been reasoned that providing heavy drinkers with information that shows their drinking to be higher than normative levels helps to resolve ambivalence (Borsari & Carey, 2000). Evidence for and against this effect has been observed within personalized interventions for college drinkers (Neighbors, Larimer & Lewis, 2004; Collins, Carey & Sliwinski, 2002; Werch et al., 2000).

The theoretical basis for feedback on alcohol expectancies as a mechanism for behavior change stems from Bandura's Social Cognitive Theory (1986, 1977). Bandura postulated that the environment provides individuals with information that form cognitions (i.e., memories) which then determine overt behavior and that this process is cyclical. This is known as reciprocal determinism. Goldman, Brown and Christiansen (1987) adopted Bandura's concepts into Alcohol Expectancy Theory and have demonstrated that young adults that believe alcohol use will lead to positive outcomes, such as enhanced performance or improved social interactions, are more likely to consume alcohol (Christiansen, Smith, Roehling & Goldman, 1989).

This concept of weighing the balance of positive and negative expectancies when making health decisions is conceptualized as a process of change known as the decisional balance in the Transtheoretical Model (TTM; Prochaska, DiClemente & Norcross, 1992; Prochaska, 2008; Migneault, Adams & Read, 2005; Prochaska et al., 1994). It was adapted from Janis and Mann's (1986; 1977) theory for rational decisional making which proposes that human beings evaluate an important decision in terms of gains and losses for the self and others. According to TTM principles, maladaptive behavior change (e.g., increasing frequency of binge drinking) occurs when one views more pros (positive expectancies) to alcohol use than cons (negative expectancies). The opposite applies to adaptive behavior change. As one transitions out of problem behavior (e.g., decreasing frequency of binge drinking), he/she will will weigh the cons of that behavior more heavily than the pros.

The TTM theorized shift in pros and cons that accompany changes in behavior have been observed in a number of acquisition and cessation studies (Migneault, Adams & Read 2005). Prochaska et al. (1994) examined the relationship between the pros and cons, measured with self-report inventories similar to the one used in this study, across twelve problem behaviors that ranged from smoking to unsafe sex. With the exception of quitting cocaine use, subjects with no plans to change problem behavior (Precontemplators) perceived higher cons to behavior change than pros (maladaptive pattern), while those that transitioned into and were maintaining healthier behavior perceived higher pros of behavior change than cons (adaptive pattern). Taken together, Alcohol Expectancy Theory and the TTM theory for decision-making provide a sound basis for motivating college students to reduce high risk drinking through feedback on alcohol expectancies and/or decisional balance. As indicated in Chapter 1, measures of these constructs are related yet differ in their associations with alcohol use (Noar, Laforge, Maddock & Wood, 2003). The decision of this author to use a decisional balance scale (pros and cons) as a measure of alcohol expectancies (positive and negative) is an attempt to dispatch the myopic straightjacket that social scientists conduct research in.

Studies evaluating the effectiveness of motivational feedback on alcohol expectancies as stand-alone interventions for reducing high risk drinking among college students are limited to decisional balance exercises (Collins & Carey, 2005; LaBrie, Pederson, Earleywine & Olsen, 2006; Collins, 2003) and alcohol expectancy challenges (Wiers & Kummeling, 2004; Darkes & Goldman, 1998; Darkes & Goldman, 1993). Further, two studies have evaluated decisional balance exercises and alcohol expectancy challenges in comparison to basic and enhanced BMIs (Wood, Capone, Laforge, Erickson & Brand, 2007; Carey, Carey, Maisto & Henson, 2006). These studies are described in the following sections.

III.B.1. Alcohol Expectancy Challenges

The underlying theoretical premise for the alcohol expectancy challenge (AEC) is that intervention-induced changes in alcohol expectancies will lead to reductions in alcohol use (Wood, Capone, Laforge, Erickson & Brand, 2007). Alcohol expectancy challenges are multi-session group interventions for college student drinkers ages 21 and older that are implemented in a simulated bar environment. Darkes and Goldman (1993) were the first to use this strategy. In their original study, a group of male volunteers (N=79) were randomly assigned to AEC, education, and assessment-only conditions. All participants were assessed on drinking behaviors, self-generated lists of positive and negative alcohol expectancies and asked to estimate the number of drinks needed to experience those outcomes. Following this assessment, those in the AEC group were required to interact with other group members. This activity was repeated in a second session.

During these sessions, half of the students were served alcoholic beverages prepared by a bartender while the other half received non-alcoholic placebos. At the end of each session, participants indicated who they believed received the alcoholic beverages, after which, actual assignments were revealed. This activity forces participants to acknowledge and reconcile erroneous assignments based on what they believe to be the expected effects of alcohol use which promotes cognitive reappraisal in alcohol expectancies (Darkes & Goldman, 1993). The challenge concluded with a final session that included an overview on expectancy theory and information on the distinctions between behavioral and pharmacological effects of alcohol.

When assessed at two-week follow-up, those assigned to the AEC condition reported levels of alcohol use that were significantly lower than students in the education and assessment-only groups. Medium to large effect sizes were achieved. Darkes and Goldman (1998) replicated these findings in a subsequent study that targeted specific expectancies and included a 6-week follow-up assessment.

Wiers and Kummeling (2004) were the first to apply AEC in groups that consisted of males and females, first in a small group (N=25) then in a study with increased recruitment (N=92). Treatment by gender interaction effects were observed in both cases. In the first study, women in the AEC condition experienced greater reductions in alcohol expectancies and alcohol use compared to control females. The second study found similar decreases in arousal and positive reinforcement expectancies for females yet increases in sedation expectancies (Wiers, Van de Luitgaarden, Van den Wildenberg & Smulders, 2005). In addition, males in the AEC condition reported fewer drinks per week and binge episodes at 1-month follow-up compared to control males.

Though most of the evidence indicates that AEC interventions produce positive effects, several studies have produced null or short-lived findings. For example, despite significant decreases in tension reduction and sexual enhancement expectancies, Musher-Eizenman and Kulick (2003) found no significant group differences in alcohol use at 6-week follow-up in a sample of at-risk college women (N=46). Similar findings were achieved in a study examining the effects of BMI and AEC interventions, alone and in combination, on alcohol use and problems.

In 2007, Wood, Capone, Laforge, Erickson and Brand conducted a rigorous, randomized factorial study to determine if a unique intervention that combined AEC and BMI approaches would outperform AEC-, BMI- and assessment-only alternatives in decreasing heavy alcohol use by college students. A total of 335 heavy drinkers were recruited and randomized, by gender, to each of the four conditions. Those assigned to the BMI and AEC group were counterbalanced to control for order effects.

That is, half of the participants received the AEC component first, followed by BMI and vice-versa. Participants were assessed on alcohol use and problems at 1, 3 and 6-month follow-ups.

Findings from this study did not support the combination of BMI and AEC in a single intervention, however, corroborate previous findings related to the effectiveness of BMI- and AEC-only approaches (Garvin, Alcorn & Faulkner, 1990; Kivlahan, Marlatt, Fromme, Coppel & Williams, 1990; Wiers, Van de Luitgaarden, Van den Wildenberg & Smulders, 2005; Wiers and Kummeling, 2004; Darkes & Goldman, 1998; 1993). Both BMI and AEC resulted in significant decreases in alcohol consumption extending to 3-months post-intervention. The BMI also exerted a positive effect on problems. By 6-month follow-up, the AEC intervention effects on alcohol consumption decayed, leading these researchers to conclude that intervention-induced changes in alcohol expectancies are more immediate and fleeting.

III.B.2. Decisional Balance Exercises

According to Janis and Mann (1986; 1977), the decisional balance exercise (DBE) is a tool that can be used to help people make better decisions (Janis & Mann, 1986; 1977). As discussed, this tool has been adopted by the Transtheoretical Model as a motivation component of a brief intervetion that can be used to facilitate healthy behavior change through guided ambivalence resolution (Prochaska, 2008; Prochaska et al., 1994). Like alcohol expectancies, feedback on decisional balance (the pros and cons of alcohol use) is a common component in interventions that use BMI (Garvin, Alcorn & Faulkner, 1990; Kivlahan, Marlatt, Fromme, Coppel & Williams, 1990). Also consistent with alcohol expectancies, DBE has been evaluated as stand-alone and

BMI-enhanced interventions for at-risk college drinkers (Collins & Carey, 2005; LaBrie, Pederson, Earleywine & Olsen, 2006; Carey, Carey, Maisto & Henson, 2006).

Specific to stand-alone interventions, the decisional balance exercise was first examined in a randomized control trial involving two different DBE modalities (Collins & Carey, 2005). In 2005, Collins and Carey recruited college students (N=131) from an introductory psychology course who self-reported a binge-drinking episode in the 2-weeks prior to the initial assessment. These students were randomly assigned to in-person decisional balance (IDB), written decisional balance (WDB) or assessment-only control (C) conditions.

Participants assigned to the IDB condition attended a brief counseling session with a trained interviewer. In the counseling session, participants were asked to identify the pros and cons of their current drinking behavior and were required to identify a plan that would help them reduce drinking by focusing on the pros of behavior change. Those assigned to the WDB condition completed these same steps in the absence of a trained interviewer through a self-administered decisional balance grid. Participants were assessed on drinking and problem behaviors at baseline, 2- and 6-weeks post-intervention. Findings from this study did not support the DBE as a stand-alone intervention for at-risk college drinkers. That is, no significant differences between groups on outcome measures were found at 2- and 6-week follow-ups. The recruitment of at-risk students (students indicating at least one binge episode in the weeks prior to the assessment) as opposed to heavy drinkers was a cited limitation of this study.

LaBrie, Pederson, Earleywine and Olsen (2006) also conducted a study evaluating the effectiveness of a DBE as a stand-alone intervention for at-risk college drinkers. Unlike Collins and Carey (2005), these researchers recruited college students from among the general population, however, their sample was smaller (N=47), male-only and included only those that self-reported sexual intercourse with two or more partners in the two months prior to the baseline assessment. Further, this study did not involve a control group nor was the DBE identical.

Participants started the DBE by self-generating a list of pros and cons for reducing current drinking behavior. To facilitate this process, participants were provided with an additional decisional balance scale for adolescent drinking (Migneault, Pallonen & Velicer, 1997) and asked to rate the items in terms of their importance. The DBE was concluded with a brief counseling session between participants and an MI-trained interviewer who highlighted the pros of behavior change.

LaBrie, Pederson, Earleywine and Olsen (2006) found statistically significant differences in motivation to change and alcohol use at 1-month follow-up. The effects of the intervention on alcohol use included significant reductions in number of intended drinks, number of drinks consumed in the past month, number of days in the past month in which drinking occurred, and peak and average drinks consumed on one occasion. A possible explanation for significant effects of this intervention relative to the intervention administered by Collins and Carey (2005) could be differences in sampling. The recruitment of sexually active males who self-reported intercourse with multiple partners over a short period of time may have resulted in a sample that was at increased risk for alcohol problems (Cooper, 2002). As a result, these students may have been more "ready" for behavior change.

To date, there has only been one study evaluating the effectiveness of an intervention for at-risk college drinkers that combined BMI and DBE components. This study was conducted by Carey, Carey, Maisto and Henson (2006) in a randomized control trial that utilized a 2 (Timeline Followback vs. No Timeline Followback) X 3 (basic BMI, BMI enhanced with DBE, assessment-only control) factorial design. The Timeline Followback interview (Sobell & Sobell, 1994) is a thorough assessment of past-90-day alcohol use, drug use and sexual behavior that is administered by a trained interviewer. The evaluation of the efficacy of the two forms of BMI interventions served as the secondary goal in this study. The study recruited 509 heavy drinking college students (i.e., students self-reporting $\geq$ 1 binge episode in an average week or four binge-drinking episodes in the last month). Follow-up assessments, which included measures of alcohol use and problems, were completed at 1, 6 and 12 months. The DBE procedure used was similar to the IDB method employed by Collins and Carey (2005).

Findings from this study showed that the addition of a DBE to the BMI did not result in significant improvement. In fact, students assigned to the Timeline Followback assessment-only condition self-reported similar levels of alcohol use and problems at the follow-up assessments. This result supports the previous findings from the Collins and Carey (2005) study. More interesting was the finding that students assigned to the basic BMI condition experienced greater reduction in alcohol use at follow-up relative to students in the BMI-enhanced condition. These researchers concluded that one explanation for the underperformance of the enhanced BMI is that the DBE component unintentionally reminded students of the many positive effects of alcohol consumption.

III.C. Change in Alcohol Expectancies Over Time

The mixed and short-lived effects of interventions targeting alcohol expectancies and decisional balance as a means to reduce high risk drinking by college students, albeit through expectancy challenges and decisional balance exercises, suggest that there is much that can be learned from a study of predictors of change in college student cognitions of positive and negative alcohol expectancies. The natural development of alcohol expectancies over time is not well understood. Developing a better understanding of change in alcohol expectancies as an underlying mechanism for change in drinking behavior is essential to development of stand-alone expectancy interventions that will produce lasting positive effects. Unfortunately, there have been few longitudinal studies of alcohol expectancies to date. Those that do exist are limited in assessment timelines or focus on extreme drinking behavior that does not represent the average college drinker (Sher, Wood, Wood & Raskin, 1996; Cronce, Fairlie, Atkins & Lee, In press).

Sher, Wood, Wood and Raskin (1996) conducted a rigorous, cross-lagged panel study of alcohol outcome expectancies and alcohol use that involved four waves of data collection. In this study, 458 students, nearly half being children of alcoholics (COAs), were recruited and assessed annually over a three-year period beginning in their first year of college. Alcohol outcome expectancies (EXP) were assessed with forty-four items measuring positive expectations of alcohol's effects across four dimensions (tension reduction, social lubrication, activity enhancement, performance enhancement). Students were not assessed on negative alcohol expectancies. Four measures of alcohol use were administered. These included total quantity/frequency (QF) of alcohol consumption and number of heavy drinking occasions (5 or more standard drinks) over the past 30 days and frequency of alcohol consumption per week and quantity of alcohol consumed per drinking occasion based on behavior in the past year.

This study produced numerous findings in support of two- (family history X time; gender X time) and three-way interaction (family history X gender X time) hypotheses. Children of alcoholics reported higher levels of EXP relative to non-COAs (on tension reduction, social lubrication, and performance enhancement dimensions) whereas males reported higher levels of EXP relative to females across all dimensions. In addition, male COAs maintained the highest levels of positive alcohol expectancies over time, female COAs maintained higher levels of positive alcohol expectancies relative to female non-COAs, and positive alcohol expectancies reduced over time for all groups.

There were notable findings specific to change in alcohol expectancies. First, EXP across all dimensions decreased significantly over the course of the trial. Second, the hypothesized pattern of reciprocal influences between EXP and alcohol use was observed. Alcohol expectancies and alcohol use were significantly associated at 3 of 4 assessments. Further, alcohol expectancies at baseline (Year 1) predicted alcohol use at Year 2 and alcohol use at baseline predicted alcohol expectancies at Year 2. This pattern was evident at the second (Year 2) and third (Year 3) assessments. With the exception of the baseline assessment, alcohol use more strongly predicted alcohol expectancies the following year whereas the lagged influence of alcohol expectancies on alcohol use weakened over time.

The study conducted by Sher, Wood, Wood and Raskin (1996) provided information on change in positive expectancies over time and the influence of gender and parent alcoholism. Both serve as predictors in the present study. It did not, however, given the annual assessments, permit short-term examination of the relationship between alcohol expectancies and use. This limitation did not apply in a recent study conducted by Patrick, Cronce, Fairlie, Atkins and Lee (In press). In their study, day-to-day variations in alcohol expectancies, use and problems were examined over 2,185 consecutive drinking days in sample of 310 college students. This study was unique in that it used a sophisticated text message and telephone interview system to conduct daily assessments. Students that met eligibility requirements (Age = 18-24 years; freshman, sophomore or junior standing) and agreed to participate completed daily interviews three times a day for 14 days in each of their next four academic quarters.

Results demonstrated a strong relation between positive alcohol expectancies, extreme binge drinking (8+/10+ drinks in a day for women/men), and positive and negative consequences. More specifically, days with extreme binge drinking were associated with reporting more positive consequences, more negative consequences and evaluating positive consequences more favorably. These findings support Sher, Wood, Wood and Raskin's (1996) finding that positive expectancies are positively correlated with alcohol use. The findings from these studies have implications for this analysis of predictors of change in college freshmen and sophomore cognitions of alcohol expectancies.

III.D. Variability in Alcohol Expectancies within College Drinking Populations: Implications for Gender, Race, Peer Influence, Greek Status, Parent Alcoholism, Cigarette and Marijuana Use

In addition to treatment condition, which is the only manipulated variable in this study, this analysis of baseline predictors of change in positive and negative alcohol expectancies examined gender, race, class year, peer influence, Greek status, parent alcoholism, binge-frequency, alcohol problems and cigarette and marijuana smoking status as potential moderators. The longitudinal studies of alcohol expectancies just reviewed supports the selection of gender, parent alcoholism, alcohol problems and binge frequency as predictors in the present study and the hypothesized moderation effects. Research investigating moderators of alcohol expectancies is limited. By comparison, study of the relation between the selected predictors, alcohol use and problems within college student populations is extensive.

What follows is a review of the relevant literature. Relations with alcohol expectancies are covered first, followed by relations with drinking outcomes. This discussion excludes direct review of research on class year and that relating binge-frequency to the experience of consequences. Class year was selected as a potential moderator because research findings show that drinking is elevated upon entry into college, after which it decreases (Bishop, Weisgram, Holleque, Lund, & Wheeler-Anderson, 2005; Capone, Wood, Borsari & Laird, 2007; Lee, Maggs & Rankin, 2006; Grekin & Sher, 2006; Hartzler & Fromme, 2003; Weitzman, Nelson & Wechsler, 2003; Adams & Nagoshi, 1999). The call to action by the National Institute on

Alcohol Abuse and Alcoholism (NIAAA) in 2002 to change the culture of drinking on college campuses and alcohol-related consequences is proof enough that college student alcohol use and problem behavior are associated (Dejong, Larimer, Wood & Hartman, 2009). According to the NIAAA College Drinking Fact Sheet (October, 2015), approximately 1,800 college students die each year from alcohol-related unintentional injuries, nearly 700,000 are assaulted by another student that has been drinking and 25% of students report issues with academics due to alcohol use.

III.D.1. Relations with Alcohol Expectancies

Research on moderators of alcohol expectancies have more commonly examined gender in combination with one or more variables. For example, Randolph, Torees, Gore-Felton, Lyod and McGarvey (2009) found a gender by race interaction in a study of alcohol use and sexual risk among college students (N=425). African-American women reported significantly less binge drinking and positive alcohol expectancies compared to White women (Randolph, Torees, Gore-Felton, Lyod & McGarvey, 2009).

In 2004, Read, Wood, Lejuez, Palfai and Slack examined the relationship between gender, alcohol consumption and differing alcohol expectancy dimensions in a sample of college drinkers (N=88). Alcohol expectancies were measured with the Comprehensive Effects of Alcohol Questionnaire (CEOA; Fromme, Stroot & Kaplan, 1993) and an adapted version of the Expectancy Accessibility task (EA; Palfai, Monti, Colby & Rohsenow; 1997). The CEOA has been described. The EA task is an objective measure of the salience of alcohol expectancies. Participants are presented with and asked to complete expectancy sentence prompts (e.g., "When I'm under the influence of alcohol it is easier to _________.") with the first behavior that comes to mind. Participant response times are then used to calculate salience scores which quantify the importance of the expectancy. Results indicated that women and, to a lesser degree, heavier drinking men more readily access positive social enhancement expectancies[2] which have been associated with initiation of alcohol use and lifetime history of alcohol consumption in a sample of young adult women (Agrawal et al., 2008) and high risk drinking by college males (Foster, Young, Bryan, Steers, Yeung & Prokhorov, 2014; Dunn & Goldman, 1998, 2000; Dunn & Yniguez, 1999).

In an earlier study, Lundhal, Davis, Adesso and Lukas (1997) examined gender, age, and family history of alcoholism as moderators of alcohol expectancies. Alcohol expectancies were measured with the Alcohol Expectancy Questionnaire (AEQ; Brown, Christiansen & Goldman, 1980), which was administered to 627 college students (69% female) who self-described as heavy drinkers. Findings indicated that alcohol expectancies varied significantly by age, gender and family history. Interaction effects were observed. Males and females under the age of 20 reported greater expectancies of positive effects, sexual enhancement and feelings of increased power and social assertion compared to those over the age of 20. Further, females under the age of 20 with a self-reported family history of alcoholism endorsed stronger expectancies of social and physical pleasure compared to females with no family history.

III.D.2. Relations with Alcohol Use and Problems

[2] Social enhancement is conceptualized as a dimension of positive alcohol expectancies in the CEOA.

III.D.2.a. Race and Gender

In the U.S., the overall prevalence of alcohol problems experienced by college students is greater for Whites. Large National surveys consistently find that Whites drink the most, followed by Hispanics and African-Americans reporting the least amount of alcohol use (O'Malley & Johnston, 2002; Del Boca, Darkes, Greenbaum & Goldman, 2004; Mounts, 2004; Weitzman, Nelson & Wechsler, 2003). There are even findings that suggest ethnic diversity on college campuses serves as a buffer against high risk drinking by White majority students. Wechsler and Nelson (2008) reported that binge drinking rates among Whites are lower on college campuses with greater racial and ethnic diversity and that, in general, students are more likely to take up binge drinking if they attend schools with smaller minority populations.

Like the disparity observed between Whites and non-Whites, males, due to a number of factors, have consistently been shown to be at a greater risk than females for heavy drinking and associated problems (Caetano, 1994; Greenfield, Midanik & Rogers, 2000; Korcuska & Thombs, 2003; Randolph, Torres, Gore-Felton, Llyod & McGarvey, 2009; Del Boca, Darkes, Greenbaum & Goldman, 2004; Kidorf, Sherman, Johnson & Bigelow, 1995; O'Malley & Johnston, 2002). One study found that women are more likely to use self-regulating tools when drinking, possibly as a strategy to reduce risk of sexual harm, and therefore experience fewer negative consequences (Kenney & LaBrie, 2013). Adams and Nagoshi (1999) found that men are more likely to perceive heavy drinking behavior as more socially acceptable on college campuses compared to women. False beliefs on descriptive and injunctive peer drinking norms have been associated with personal alcohol use and problems

(Lewis & Neighbors, 2004; Larimer, Turner, Mallett & Geisner, 2004; Borsari & Carey, 2001; White & Labouvie, 1989; Perkins & Berkowitz, 1986).

There is some evidence that females are more susceptible to the experience of alcohol-related problems. Ahmed, Hustad, LaSalle and Borsari (2014) recently conducted a study of "pregaming" induced hospitalizations in a sample of undergraduates (N=516) and found that female students that "pregame" (i.e., the act of drinking prior to an event in which further drinking will occur) are at a significantly greater risk for requiring medical attention after a drinking episode. Important to note is the fact that females are more likely to be the victims of sexual assault and rape during or after drinking situations (Nicholson et al., 1998; Ullman, Karabatsos & Koss, 1999; Abbey & McAuslan, 2004; Abbey, Ross, McDuffie & McAuslan, 1996; Abbey, 1991).

III.D.2.b. Peer Influence and Greek Status

Peer influence is one of the strongest predictors of the initiation of alcohol use by adolescents and prolonged alcohol use by college students (Lo & Globetti, 1993; Reifman & Watson, 2003; Baer, Kivlahan & Marlatt, 1995; Wood, Read, Palfai & Stevenson, 2001). Recently, Read, Wood and Capone (2005) conducted a longitudinal investigation of relations between social influences and alcohol involvement over two years in a sample of college freshmen (N=388) that employed a measure of peer influence similar to the one used in the present study. This measure consisted of 4 items that queried participants on the drinking attitudes and alcohol use of close friends (Jessor, Jessor & Donovan, 1981; Wood, Read, Palfai & Stevenson, 2001). Results indicated that self-reported peer influence the summer preceding freshmen year predicted alcohol use and problems at two-year follow-up. Alcohol use the summer preceding freshmen year also predicted peer influence at two-year follow up. Fairlie, Wood and Laird (2010) arrived at a similar finding in a study of the protective effects of parents on peer influences and college alcohol involvement. That is, peer influence among peers was found to be positively associated with initial heavy drinking of students upon entry into college. Moreover, Carey, Henson, Carey and Maisto (2007) observed that heavy drinking college students that frequently engage in social comparison were less likely to reduce drinking outcomes following a brief motivational intervention.

Research on how peers influence alcohol use by college students has led to important insights that are especially relevant in collegiate Greek systems. Social fraternities and sororities offer an environment where alcohol use is an integral part of peer interaction, the number of overt offers and drinking expectations are increased, and students are more likely to experience ridicule if they abstain from alcohol use (Borsari & Carey, 2006; Borsari & Carey, 2001). Group size is a reported factor. Perkins and Berkowitz (1986) found that students self-report consumption of greater amounts of alcohol when in larger drinking groups. Senchak, Leonard and Greene (1998) observed a group size by gender interaction effect in a study of alcohol use as a function of typical social drinking context. Men reported greater frequency of drunkenness in large groups of mixed-sex and small same-sex groups. Women's frequency of drunkenness was not related to either.

There is ample research available that indicates Greek membership is strongly related to heavier alcohol use (Cashin, Presley & Meilman, 1998; Engs, Diebold &

Hanson, 1996; Wechsler, Dowdall, Davenport & Castillo, 1995; Faulkner, Alcorn, & Garvin, 1989; Lichtenfield & Kayson, 1994). In 1998, Cashin, Presley and Meilman surveyed more than 25,000 students from sixty-one colleges and found that Greek members consumed greater amounts of alcohol more frequently and experienced more problems as a result of that alcohol use compared to non-affiliated students. Sher, Bartholow and Nanda (2001) arrived at similar findings in their study of short- and long-term effects of Greek membership on heavy drinking. Results indicated that increased drinking by fraternity and sorority members does not persist beyond the college years. Consistent with the literature on gender differences in college student alcohol use and problems, the effects of Greek involvement on heavy drinking are more pronounced for men (Bartholow, Sher & Krull, 2003; Grekin & Sher, 2006; Kahler, Read, Wood & Palfai, 2003).

III.D.2.c. Parent Alcoholism

Studies examining the effects of parent alcoholism on offspring alcohol use and related problems have produced mixed findings (Engs, 1990; Alterman, Searles & Hall, 1989; Havey & Dodd, 1993; Kusher & Sher, 1993; Baer, 2002). Engs (1990) investigated the association between positive family history of alcohol abuse (i.e., having a parent or grandparent that sometimes or often drank to much) among a nationally representative sample of college students (N=970) and found no significant differences in rates of drinking between students that do and do not report a history of parent drinking problems. Alterman, Searless and Hall (1989) and Havey and Dodd (1993) reported similar findings. In their study of comorbidity of alcohol and anxiety disorders among college students, Kusher and Sher (1993) found that alcohol use disorder rates were higher among children of alcoholics (COAs).

Perhaps the most compelling evidence of the association between parent alcohol use and teen drinking and problems comes from two sources. The first is a 21-year longitudinal analysis of the effects of early parent alcohol use (Baer, Sampson, Barr, Connor & Streissguth, 2003). In this study, parent alcohol and other substance use as well as many aspects of the family environment were assessed on seven occasions. Offspring (N=433) alcohol use and problems were measured with a self-report quantity by frequency measure and the Alcohol Dependence Scale (ADS; Skinner & Horn, 1984). The ADS is a widely used, 25-item scale that assesses frequency of a wide range of drinking problems from "blackouts" to symptoms of dependence. Findings indicated that early parent substance use, even prenatal exposure, was significantly associated with offspring alcohol problems at 21 years. Though this study is not specific to parent alcoholism, results show that less problematic parent alcohol use is associated with child alcohol problems later on in life.

The second is a longitudinal follow-up study on the relation between parent alcoholism and adolescent substance use (Chassin, Curran, Hussong & Colder, 1996). Results revealed that parent alcoholism significantly raised the risk of alcohol and drug use by teens during adolescence and that the effects of parent alcoholism were partially mediated by socialization (deficit in parent support), stress and negative affect (undue environmental stress) and temperament (emotional reactivity and under-regulation) pathways.

III.D.2.d. Cigarette and Marijuana Use

Most of the information available on the relationships between alcohol, cigarette and marijuana use by college students was collected as part of extensive National surveys such as the CAS (Wechsler & Nelson, 2008) and the National College Health Risk Behavior Survey (Jones, Oeltmann, Wilson, Brener & Hill, 2001). While correlational in nature, these surveys have found that binge drinkers are more likely to report ever using (as well as current use of) cigarettes and marijuana (Jones, Oeltmann, Wilson, Brener & Hill, 2001) and that marijuana use is higher among students who participate in other high risk behaviors such as binge drinking and tobacco use (Bell, Wechsler & Johnston, 1997; Mohler-Kuo, Lee & Wechsler, 2003). In the case of smoking, there are a few, more rigorous studies that support these findings.

In their examination of concurrent use of alcohol and tobacco as well as the relationship between alcohol use and smoking initiation among a sample of undergraduate students (N=1113), Reed, Wang, Shillington, Clapp and Lange (2007) found that tobacco experimenters and smokers reported greater alcohol consumption than nonsmokers. This effect was present across two measures of alcohol use (average drinks per occasion in the past 28 days; peak number of drinks in the past two weeks) even after controlling for demographic covariates. The classification of students into nonsmoker, experimenter and smoker categories is similar to the grouping employed in the present study (nonsmoker, infrequent, frequent).

More recently, Myers, Neal, Edland, Schweizer and Wall (2013) conducted a study on the association between college student smoking initiation and future alcohol involvement. A total of 104 undergraduates who, during their freshmen year, reported never having smoked a cigarette were assessed annually on tobacco and alcohol use. Results indicated that participants who initiated smoking during college reported significantly greater increases in heavy drinking episodes and in the number of drinks consumed in the past 30 days. Though strong, there is a question regarding the generalizability of these findings to the general population of undergraduates. All participants were Asian-American.

III.E. Literature Review Summary

This section provided a review of literature relevant to the present study beginning with the state of college student drinking and the problems it poses and concluding with an overview of studies examining the relationships between the selected predictors, alcohol expectancies, use and related problems. Important details that were covered include the rationale for using measures of rational decision-making (the Pros and Cons of Alcohol Consumption) as indices of positive and negative alcohol expectancies and directionality (positive or negative association) between the selected predictors, alcohol expectancies, use and related problems. The literature supports the selection of predictors examined in this study as potential baseline moderators of change in alcohol expectancies.

IV. Research Questions and Hypotheses

Two primary research questions are addressed in this study of predictors of change in college freshmen and sophomore cognitions of alcohol expectancies. The first question deals with how positive (Pros) and negative (Cons) alcohol expectancies develop over a two year period early in the college experience when heavy drinking is most prevalent (Adams & Nagoshi, 1999; Lee, Maggs & Rankin, 2006; Bishop, Weisgram, Holleque, Lund & Wheeler-Anderson, 2005; Hartzler & Fromme, 2003). Hypotheses for change in Pros and Cons were developed from a number of sources including the findings from the Sher, Wood, Wood and Raskin (1996) longitudinal cross-lagged panel study and cross-sectional studies demonstrating positive correlations between alcohol use and positive expectancies (Stacy, Widaman & Marlatt, 1990; Jones, Corbin & Fromme, 2001; Borsari, Murphy & Barnatt, 2007; Del Boca, Darkes, Greenbaum & Goldman, 2004).

Findings suggest that changes in alcohol use will be accompanied by complimentary shifts in Pros. Taken together with longitudinal studies of alcohol use by college students that have found that alcohol consumption increases at the start of college and gradually declines over time (Del Boca, Darkes, Greenbaum & Goldman, 2004; Greenbaum, Del Boca, Wang & Goldman, 2005; Chassin, Pitts & Prost, 2002), it is hypothesized that Pros will increase at the start of the CBARR trial and gradually reduce over the remainder of the study. Cons are not expected to follow the same trajectory. In their comparison study of alcohol expectancy and decisional balance, Noar, Laforge, Maddock and Wood (2003) found that Cons were negatively associated with alcohol use. Further, research on TTM stage progression out of problem behavior indicates that Cons will be lowest when students are engaging in heavier alcohol use (Prochaska et al., 1994). These findings suggest that Cons will decrease at a faster rate at the start of the CBARR trial then gradually over time alongside natural decreases in alcohol use. The hypotheses for unconditional change in positive and negative alcohol expectancies are:

H1: Positive alcohol expectancies will increase initially then experience a reduction over time; and

H2: Negative alcohol expectancies will decrease over time with the greatest reduction occurring initially.

The second research question is specific to the effect(s) of the selected predictors on change in alcohol expectancies over time. These questions can only be addressed after identifying the temporal form of change in Pros and Cons (i.e., the focus of the first research question). The potential moderation effects of treatment are examined first. By design, the personalized feedback reports provided to students randomized to the treatment condition were intended to reduce Pros over the first six months of the study. Although there was no "like" strategy targetting Cons during that time period, the demonstrated effectiveness of BMIs in reducing high risk alcohol use and problems suggests that adaptive changes in Cons are probable (Borsari & Carey, 2000; Borsari & Carey, 2005; Wood, Capone, Laforge, Erickson & Brand, 2007; Fromme & Corbin, 2004). The hypotheses related to treatment as moderator of change in alcohol expectancies are:

H3: The moderation effects of treatment condition will be stronger for change in Pros; and

H4: Students randomized to the treatment condition will experience and maintain more adaptive change in Pros (lower Pros) and Cons (higher Cons) relative to those assigned to the assessment-matched condition.

Change in Pros and Cons among the assessment-matched control group is regarded as natural change.

The remaining predictors of gender, race, class year, parent alcoholism, peer influence, Greek status, binge frequency, alcohol-related problems, cigarette and marijuana use were examined after treatment. Research investigating the effects of these variables on change in alcohol expectancies is limited. The literature review identified studies that found associations between alcohol expectancies and gender, race, parent alcoholism, heavy drinking and alcohol-related problems (Sher, Wood, Wood & Rasking, 1996; Randolph, Torres, Gore-Felton, Lyod & McGarvey, 2009; Patrick, Cronce, Fairlie, Atkins & Lee, In press; Foster, Young, Bryan, Steers, Yeung & Prokhorov, 2014; Read, Wood, Lejuez, Palfai & Slack, 2004; Lundhal, Davis, Adesso & Lukas, 1997). In short, males, Whites, children of alcoholics, heavier drinkers and students experiencing more problems as a result of their alcohol use have been found to perceive greater Pros to alcohol use.

The literature that associates these variables with alcohol use and problem outcomes is extensive (Baer, 2002; Kusher & Sher, 1993; Perkins & Berkowitz, 1991; Pullen, 1994; Chassin, Curran, Hussong & Colder, 1996; Lo & Globetti, 1993; Reifman & Watson, 2003; Adams & Nagoshi, 1999; Weitzman, 2004; Korcuska & Thombs, 2003; Caetano, 1994). This also applies to Greek affiliation (Lewis & Neighbors, 2004; Adams & Nagoshi, 1999; Ahmed, Hustad, LaSalle & Borsari, 2014; Kenney & LaBrie, 2013) and cigarette and marijuana use (Jones, Oeltmann, Wilson, Brener & Hill, 2001; Reed, Wang, Shillington, Clapp & Lange, 2007; Bell, Wechsler & Johnston, 1997; Mohler-Kuo, Lee & Wechsler, 2003). Binge frequency is positively correlated with the experience of alcohol related problems by college students (O'Malley, 2002; Johnston, O'Malley & Bachman, 1996; NIAAA, 2015). Further, class year was selected as a potential moderator with respect to research findings that drinking is elevated upon entry into college, after which it decreases (Bishop, Weisgram, Holleque, Lund, & Wheeler-Anderson, 2005; Capone, Wood, Borsari & Laird, 2007; Lee, Maggs & Rankin, 2006; Grekin & Sher, 2006; Hartzler & Fromme, 2003; Weitzman, Nelson & Wechsler, 2003; Adams & Nagoshi, 1999). Taken together, the literature support the following hypothesis on the relationship between these baseline predictors and change in alcohol expectancies:

H5: Females, non-Whites, sophomores, non-Greek members, students with low binge frequency, alcohol problems, peer influence and no parent alcoholism and that do not smoke cigarettes or marijuana will experience and maintain more adaptive change in pros and cons over time than their respective peer groups.

No hypotheses were proposed for analyses examining these baseline predictors as moderators of potential treatment effects on change in alcohol expectancies. There is evidence that the effects of treatment will be similar for males and females (Wood, Capone, Laforge, Erickson & Brand, 2007) and that heavier drinkers will benefit more from the intervention relative to lighter drinkers (Borsari & Carey, 2000; Borsari & Carey, 2005; Doumas, McKinley & Book, 2008).

V. Significance of the Study

This study is significant for multiple reasons. To the best of this author's knowledge, this is the first comprehensive study of predictors of change in college student cognitions of alcohol expectancies. This is surprising considering the long history of investigations devoted to the examination of the relationship between alcohol expectancies, use and problems. Expectancies have been found to both moderate and mediate alcohol consumption and the experience of alcohol related problems by college students (Rohsenow, 1983; Leigh, 1989; Christiansen, Roehling, Smith & Goldman, 1989; Wood, Nagoshi & Dennis, 1992; Borsari, Murphy & Barnatt, 2007; Wood, Read, Palfai & Stevenson, 2001), are consistently found to be concurrent predictors of drinking patterns of young adults (Leigh, 1989; Christiansen, Roehling, Smith & Goldman, 1989; Wood, Nagoshi & Dennis, 1992), and have even demonstrated greater predictive validity for drinking than combinations of demographic variables (Christiansen & Goldman, 1983; Brown, 1985).

The richness of the data collected in the CBARR study provides the opportunity to examine how Pros and Cons change over time and whether numerous factors (e.g., gender, race, binge-frequency, other substance use) known to be related to expectancy beliefs, alcohol use and experience of alcohol-related problems moderate that change. This investigation sets the stage for future studies examining the relationship between change in Pros and Cons, alcohol use and alcohol problems over time.

The CBARR study design also permits an examination of short- and long-term change in alcohol expectancies during a time when high-risk drinking by college students is at its peak. This was not a characteristic nor was it the exact focus in other longitudinal studies of alcohol outcome expectancies (Patrick, Cronce, Fairlie, Atkins & Lee, In press; Sher, Wood, Wood & Raskin, 1996). The timing of assessments was situated so that measures were administered three months apart at the beginning of the trial (at 0, 3 and 6 months) and 6 months apart at the end of the trial (at 12, 18 and 24 months). In addition, the CBARR study sampling procedure, which recruited freshmen and sophomore students from among the general population of student drinkers, facilitates the generalizability of current findings.

A final reason this study is warranted is directly related to matters of clinical significance. Feedback to aid self-evaluation of the perceived benefits and risks of high risk drinking behaviors is a common element in BMI prevention efforts (Rollnick & Miller, 1995; Miller & Rollnick, 2003; Dimeff, 1999). Challenges to alcohol expectancies and decisional balance have even served as targets in intervention efforts to reduce alcohol use and problems by college students (Carey, Scott-Sheldon, Carey & DeMartini, 2007; Collins & Carey, 2005; Bosari & Carey, 2000). This study, which focuses solely on the development of alcohol expectancies over time in the context of a BMI intervention, concludes with analyses of the selected predictors as moderators of the effects of treatment on change in alcohol expectancies. These analyses have the potential to inform not only alcohol expectancy intervention timing, but for whom these interventions may be most effective; all while accounting for individual differences in change in alcohol expectancies

VI. Summary

This chapter introduced the goal of the present study which is to examine predictors of change in college freshmen and sophomore cognitions of alcohol expectancies. This problem is addressed within the context of a harm reduction intervention (CBARR study) that used brief motivational interviewing to reduce high risk drinking by college students. In addressing this problem, three objectives will be satisfied. The first is to determine how college student cognitions of alcohol expectancies (measured with the Pros and Cons of Alcohol Consumption) change over a two year period. Second, in addition to treatment, demographic, peer influence, family history, alcohol-use related and other substance use factors are examined as potential moderators of change in alcohol expectancies. Third, moderators of treatment effects on alcohol expectancies are explored. This study is meant to extend the alcohol expectancy literature and has the potential to inform intervention efforts that seek to effect change in high risk drinking behavior by college students through feedback designed to aid self-evaluation of the perceived benefits and risks of alcohol use.

CHAPTER 2

METHODS

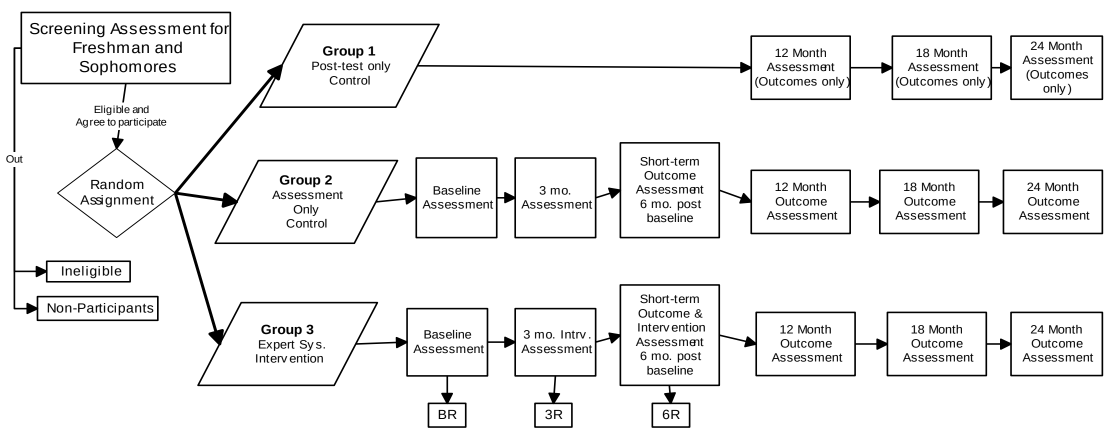
I.A. Longitudinal Data Set

The data for this study was obtained from 1st and 2nd year college students matriculated at the University of Rhode Island from 2000-2002. These students were originally recruited for the College-Based Alcohol Risk Reduction (CBARR) study which was funded by the NIAAA (1 R01 AA12068-01). The CBARR study recruited a population-based sample of students who were potentially "at-risk" for alcohol abuse which included both lighter drinkers as well as students identified as "high risk" or "heavy" drinkers. In order to be eligible for the study, students had to be full-time freshmen or sophomore students enrolled at the main campus in the Fall semester of 1999. Further, students must have consumed at least 2 drinks in the year prior to the study and never received or been referred to treatment for alcohol use.

Figure 1 provides a flowchart of the CBARR study design. At the start of the study students were administered the AUDIT (Bohn, Babor & Kranzler, 1995) and Alcohol Dependence Scale (ADS; Skinner & Horn, 1984). Those that screened positive for alcohol dependence (i.e., ADS > 20) were ineligible and referred out to other treatment. The intervention was not suited for individuals with alcohol dependence. Those that were elibile were randomized to 1 of 3 conditions. The present student uses data collected from students that were randomized, by gender and stage readiness to reduce binge drinking, to Groups 2 and 3. Respectively, these are the assessment-only control (AM Control, N = 534) and expert-system intervention conditions (Treatment, N=533). The decision to use data collected from these students stemmed from the fact that they were assessed on the dependent measures at baseline (0 months or Wave 1), 3 (Wave 2), 6 (Wave 3), 12 (Wave 4), 18 (Wave 5) and 24 (Wave 6) months. Group 1 was only assessed at the final 3 time points. The data collected from AM Control and Treatment students is better suited for longitudinal study of change in alcohol expectancies.

Figure 1

CBARR study design



Note. BR = Baseline Feedback Report, 3R = 3 month Feedback Report, 6R = 6 month Feedback Report

I.B. Participants

A total of 1,067 students were randomized to the AM Control and Treatment conditions. This sample consisted of slightly more females (56%) than males, more freshmen (55%) than sophomores, was predominantly White (88%), and was made up of a larger proportion of students (84%) not affiliated with a fraternity or sorority at baseline. Few students (18%) responded "Yes" when surveyed on whether or not they believed one or more of their parents is (or was) an alcoholic. Though disproportionate, race, Greek status and parent alcoholism subgroups were large enough to assess group differences on change in alcohol expectancies over time. Ethnicity could not be used as only 54 students (5%) identified as Hispanic.

Table 1

Summary of baseline Pros and Cons descriptive statistics by predictor variable

		Pros			Cons		
Predictor	Level	N	Mean	SD	N	Mean	SD
Treatment Condition	AM Control	534	14.14	4.47	534	17.73	4.70
	Treatment	533	13.98	4.47	533	17.64	5.19
Gender	Male	471	14.58	4.56	471	17.20	4.95
	Female	596	13.65	4.36	596	18.06	4.92
Race	White	939	14.26	4.41	939	17.57	4.86
	Non-White	126	12.59	4.66	126	18.53	5.53
Class Year	Freshman	588	14.44	4.57	586	17.63	4.87
	Sophomore	475	13.60	4.31	475	17.80	5.01
Greek Status	Member	164	14.48	4.08	164	17.79	5.15
	Non-Member	894	13.98	4.55	894	17.65	4.91
Peer Influence	Low ($s \leq 10$)	354	12.20	4.44	354	18.14	5.48
	Med ($11 \leq s \leq 14$)	345	14.27	4.15	345	17.86	4.77
	High ($s \geq 15$)	359	15.73	4.10	359	17.00	4.47
Parent Alcoholism	None	870	13.98	4.52	870	17.67	4.99
	One or both parents	197	14.41	4.25	197	17.75	4.77
Binge Frequency	Low ($f = 0$)	306	11.64	4.33	306	18.90	5.58
	Mild (f = 1-2)	297	13.91	4.18	297	18.10	4.87
	Mod (f = 3-4)	169	15.34	3.98	169	16.88	4.21
	High ($f \geq 5$)	295	15.99	3.94	295	16.46	4.33
Alcohol Problems	Low ($s \leq 0$)	240	10.70	4.11	239	17.81	5.65
	Mild ($1 \leq s \leq 2$)	228	13.14	3.96	227	18.36	5.14
	Mod ($3 \leq s \leq 5$)	274	14.80	3.64	273	17.51	4.64
	High ($s \geq 6$)	320	16.58	3.94	321	17.33	4.37
Cig. Smoking Status	Nonsmoker	538	13.30	4.55	538	17.75	5.08
	Infrequent Smoker	280	14.72	4.12	279	18.06	4.74
	Frequent Smoker	244	15.01	4.41	243	17.19	4.81
Mar. Smoking Status	Nonsmoker	444	12.92	4.42	442	18.24	5.13
	Infrequent Smoker	269	14.41	4.35	270	18.42	4.91
	Frequent Smoker	347	15.27	4.29	346	16.48	4.48

Note. Pros and Cons of Alcohol Use serve as measures of positive and negative alcohol expectancies. N = total number of cases; SD = standard deviation; *f* = frequency; *s* = score; AM = assessment-matched; Med = medium; Mod = moderate; Cig. = cigarette; Mar. = marijuana.

As indicated in Table 1, equal numbers of participants were assigned to treatment conditions with near equivalence in mean Pros ($\text{Mean}_{\text{AM Control}}$=14.14, $\text{Mean}_{\text{Treatment}}$=13.98) and Cons scores ($\text{Mean}_{\text{AM Control}}$=17.73, $\text{Mean}_{\text{Treatment}}$=17.64) at baseline. Thorough review of the information provided in Table 1 provides initial insight into relevant differences on alcohol expectancies between subgroups of individuals across the selected demographic, social, family history, alcohol-related, and substance use predictors. Significant differences aside, it is clear that males, Whites, freshmen, students subject to high peer influence, students with 1 or more alcoholic parents, students that more often engage in binge drinking, students experiencing a higher level of problems as a result of their alcohol use, and students that report frequent smoking of tobacco and marijuana all have higher Pros scores compared to their peers. Excluding gender, Greek status and parent alcoholism classifications, these subgroups also had lower Cons scores at baseline.

II. *Dependent Variables*

II.A. *Positive Alcohol Expectancies*

Positive alcohol expectancies were measured with a 6-item subscale of the Decisional Balance for Alcohol Use known as the Pros of Alcohol Consumption (Pros; Laforge, Krebs, Kypri & Maddock, 2005). This measure was adapted from the Decisional Balance for Immoderate Drinking (Migneault, Velicer, Prochaska & Stevenson, 1999). Sample items include: (1) "It is easier to talk to someone I am attracted to after a few drinks" and (2) "Drinking makes me more relaxed and less tense". The full Pros scale can be found in Appendix B.

Participants were required to rate "*HOW IMPORTANT*" these items were when making decisions about how much to drink using a 5-point Likert scale that ranged from 0 (Not at all important) to 4 (Extremely important). Scale items demonstrated high internal consistency within this sample across assessments for participants in both the assessment-matched and treatment conditions. As shown in Table 2, the lowest Cronbach's coefficient alpha (Cronbach, 1951) for Pros items is .83. As a general rule, Cronbach's coefficient alphas (α) that are greater than or equal to .80 are indicative of good internal consistency (George & Mallery, 2003).

Table 2

Internal consistency of Pros and Cons scale items over time

		Time (Years)					
		0	.25	.5	1	1.5	2
Pros (6 items)	N	1063	915	864	808	717	725
	α	.83	.85	.87	.87	.86	.86
Assessment-Matched	N	530	452	430	394	353	354
	α	.83	.86	.88	.86	.87	.86
Treatment	N	533	463	434	414	364	371
	α	.82	.84	.87	.87	.86	.86
Cons (6 items)	N	1061	915	863	809	717	724
	α	.74	.73	.79	.78	.79	.81
Assessment-Matched	N	533	452	429	394	353	353
	α	.71	.75	.82	.79	.80	.84
Treatment	N	528	463	434	415	364	371
	α	.76	.71	.76	.78	.79	.78

Note. N = total number of cases.

Pros items were summed to create a continuous Pros score that ranged from 0 to 24. In a study conducted by Maddock, Laforge, Rossi and O'Hare (2001), a similar measure for Pros (Maddock, 1997) was positively correlated with the summary CAPS-r score ($r(661) = .34$, $p < .01$), the standardized measure for alcohol-related problems used in the present study. In addition, Noar, Laforge, Maddock and Wood (2003) found a strong positive correlation ($r(389) = .64$, $p < .01$) between that same Pros measure and positive alcohol expectancies measured with the Comprehensive Effects of Alcohol Scale (CEOA; Fromme, Stroot & Kaplan, 1993). As shown in Table 3, the summary Pros score used as a depedent measure in this study is positively correlated with indices of heavy drinking and alcohol problems over time. These findings indicate that increases in Pros are associated with increases in alcohol use and related problems.

Table 3

Correlations between Pros and drinking-related variables over time

		Alcohol Use		Alcohol Problems	
		Binge frequency	Peak drinks	YAAPST score	CAPS-r score
Time (Years)					
0	N	1063	1063	1062	1062
	r	.30***	.35***	.37***	.46***
.25	N	915	915	903	903
	r	.33***	.34***	.39***	.46***
.5	N	864	864	857	857
	r	.31***	.31***	.39***	.43***
1	N	807	808	801	801
	r	.34***	.33***	.37***	.47***
1.5	N	717	717	714	714
	r	.35***	.37***	.41***	.49***
2	N	725	725	722	721
	r	.31***	.31***	.41***	.48***

Notes. Binge frequency is the number of occasions in which male respondents consumed 5 or more drinks (4 or more drinks for females) in the past month. Peak drinks is the highest number of drinks consumed in the past 30 days. N = total number of cases; YAAPST = Young Adult Alcohol Problems Screening Test; CAPS-r = College Alcohol Problems Scale – revised.
***$p < .01$.

II.B. Negative Alcohol Expectancies

Negative alcohol expectancies were measured with a 6-item subscale of the Decisional Balance for Alcohol Use known as the Cons of Alcohol Consumption (Cons; Laforge, Krebs, Kypri & Maddock, 2005). Both Pros and Cons subscales share the same question prompt, response format, high scale reliability (see Table 2) and scoring (i.e., scale items are summed to create a score that ranged from 0 – 24 points). Cronbachs coefficient alphas for Cons range from .71 (acceptable) to .84 (good).

The primary difference between Pros and Cons is that Cons scale items focus on perceived negative consequences associated with alcohol use as opposed to benefits. Sample items include: (1) “Drinking too much could make me do things that I regret” and (2) “Drinking too much can make me less attractive to others”. A full listing of Cons scale items can be found in Appendix B. Similar to Pros, Cons have been found to correlate positively ($r(389) = .27$, $p < .01$) with negative alcohol expectancies measured with the COEA (Noar, Laforge, Maddock & Wood, 2003). Within this sample and across assessment, Cons correlated negatively with indices of heavy drinking. This can be observed in Table 4.

Table 4

Correlations between Cons and drinking-related variables over time

		Alcohol Use		Alcohol Problems	
		Binge frequency	Peak drinks	YAAPST score	CAPS-r score
Time (Years)					
0	N	1061	1061	1060	1060
	r	-.18***	-.20***	-.10***	-.03
.25	N	915	915	903	903
	r	-.15***	-.14***	.01	.07**
.5	N	863	863	856	856
	r	-.08**	-.07**	.06*	.14***
1	N	808	809	802	802
	r	-.13***	-.12***	.00	.08**
1.5	N	717	717	714	714
	r	-.09**	-.09**	.00	.08**
2	N	724	724	721	720
	r	-.13***	-.13***	-.03	.08**

Notes. Binge frequency is the number of occasions in which male respondents consumed 5 or more drinks (4 or more drinks for females) in the past month. Peak drinks is the highest number of drinks consumed in the past 30 days. N = total number of cases; YAAPST = Young Adult Alcohol Problems Screening Test; CAPS-r = College Alcohol Problems Scale – revised.
*$p < .10$, **$p < .05$, ***$p < .01$.

The relationships between Cons and alcohol problems are not consistent in valence over time. For example, at baseline (0 years) Cons are negatively correlated with YAAPST ($r(1060) = -.10$, $p < .01$) and CAPS-r ($r(1060) = -.03$, $p = .30$) yet at 3, 6, 12 and 18 months the measures are positively correlated. More interesting are the significant positive correlations between Cons and CAPS-r scores at all post-baseline assessments. These findings indicate that increases in Cons are associated with decreases in alcohol use and provide some evidence that increases in Cons are associated with increases in alcohol problems.

III. Predictors of Change in Alcohol Expectancies

III.A. Treatment Condition

Treatment condition is a manipulated variable that served as a binary categorical predictor of change in alcohol expectancies. Students randomized to the treatment condition were assessed on drinking behaviors and cognitive processes at baseline, 3-, 6-, 12-, 18- and 24-months. More importantly, these students received tailored motivational feedback reports by mail after the first three assessments. Those assigned to the assessment-matched condition did not receive tailored feedback reports, however, were assessed on drinking behaviors and cognitive processes at each time point. Treatment condition was coded so that the assessment-matched condition served as the reference group in linear mixed effects regression tests of conditional growth (Treatment = 1; Assessment Matched = 0).

III.B. Gender, Race, Class Year, Greek Status, Parental Alcoholism, Binge Frequency, Cigarette and Marijuana Smoking Status

Gender, race, class year, Greek status, parent alcoholism, binge frequency, cigarette smoking status and marijuana smoking status, like treatment condition, were treated as baseline categorical predictors of change in alcohol expectancies. These variables were measured at the start of the study within a comprehensive battery. Gender, race, class year, Greek status and parent alcoholism were operationalized as binary categorical variables. Gender and class year already existed as binary variables and were coded to: (a) gender (1=Male, 0=Female) and (b) class year (1=Freshmen, 0=Sophomore).

Parent alcoholism was surveyed with two questions. The first asked students to indicate if they believed their mother is or has ever been an alcoholic. The second asked students to indicate if they believed their father is or has ever been an alcoholic. Participants that responded "Yes" to either question were categorized into one group labeled "One or both parents". Those that responded "No" to both questions were categorized into a group labeled "None" (1=One or both parents, 0=None).

Due to the lack of minority representation in this sample, race was recoded into a binary variable where all non-Whites were categorized into one group (1=Whites, 0=Non-Whites). Similarly, Greek status, which was assessed with the question, "Are you a member of a fraternity or sorority?", was recoded so that individuals who responded "Yes I am a member/pledge" or "No, but I plan to rush a fraternity or sorority" were classified as "Members" and individuals who responded "No, and I don't plan to rush a fraternity or sorority" were classified as "Non-Members" (1=Member, 0=Non-Member). As with the assessment-matched condition, all classifications coded to "0" served as the reference group in linear mixed effects regression (LMER) analyses of conditional growth. This also applies to the categorizations of baseline peer influence, binge-frequency, cigarette and marijuana smoking status. A summary of all predictors, levels and reference coding.
is provided in Table 5.

Binge frequency was assessed retrospectively with the question, "In the LAST MONTH, how many times have you had FIVE or more (FOUR or more for females) drinks in a row?" As indicated in Table 1, participant responses were used to classify individuals into the following groups: (0) 0 binge episodes [Low], (1) 1-2 binge episodes [Mild], (2) 3-4 binge episodes [Moderate], and (3) 5 or more binge episodes [High]). The majority of students (29%) self-reported zero binge episodes at baseline.

Table 5

Summary of baseline predictors, subgroups and LMER reference code

Predictors	Levels	Reference Code
Treatment Condition	Treatment	1
	Assessment-Matched	0
Class Year	Freshmen	1
	Sophomore	0
Gender	Male	1
	Female	0
Race	White	1
	Non-White	0
Greek Status	Member	1
	Non-Member	0
Peer Influence	High	2
	Medium	1
	Low	0
Parental Alcoholism	Yes	1
	No	0
Binge-Frequency/ Alcohol-related Problems	High	3
	Moderate	2
	Mild	1
	Low	0
Cigarette/ Marijuana Smoking Status	Frequent Smoker	2
	Infrequent Smoker	1
	Nonsmoker	0

Cigarette and marijuana smoking status were assessed at the beginning and end of the CBARR study with the question(s) "Have you smoked cigarettes [marijuana] in the past year?". Participants were required to describe their cigarette smoking status by selecting either "No", "Yes, I am a regular smoker", or "Yes, I am an infrequent smoker (e.g., less than 1 pack in the past year)" and their marijuana smoking status by selecting "No", "Yes, I smoked marijuana 6 or more times in the past year", or "Yes, I smoked marijuana less than 6 times in the past year". Responses were recoded so that participants were classified as "Nonsmokers", "Infrequent Smokers", and "Frequent Smokers". These classifications were coded as 0, 1 and 2 respectively. Table 3 provides a summary of all categorical moderators, subgroups and associated reference coding used in linear mixed effects regression (LMER) tests of conditional growth.

III.C. Peer Influence

Peer influence was measured with a 5-item questionnaire at the baseline, 3-, 6- and 12-month assessments. This study uses the data collected at baseline. The 5-item scale measured the quantity and frequency of alcohol use by peers as well as their attitudes towards drinking and getting drunk. Sample items include: (1) "How do most of your close friends feel about drinking?" and (2) "When people where you live drink, how much does each person drink?". A complete listing of Peer Influence scale items can be found in Appendix C. All items were measured on a 5-point Likert scale coded 0 to 4. The Peer Influence scale demonstrated acceptable internal consistency ($\alpha = .76$) at baseline.

Like Pros and Cons scale items, peer influence items were summed to create a continuous score that ranged from a low score of 0 to a high score of 20. Once quantified, participant scores were used to classify individuals into "Low" ($s \leq 10$), "Medium" (s =11 to14) and "High" ($s \geq 15$) peer influence groups. This breakdown resulted in subgroups that were roughly equivalent in size. The proportions of students categorized in each group were 33%, 33% and 34% respectively.

III.D. *Alcohol Problems*

Alcohol problems were measured with the 8-item College Alcohol Problems Scale-revised (CAPS-r; Maddock, Laforge, Rossi & O'Hare, 2001). This scale demonstrated high internal consistency within this sample at the baseline assessment ($\alpha = .75$), demonstrated gender invariance, and had a strong positive correlation ($r(661) = .78$, $p < .01$) with an alternative measure of alcohol problems known as the YAAPST (Maddock, Laforge, Rossi & O'Hare, 2001). Sample items include: (1) "As a result of drinking, how often have you felt sad, blue or depressed?" and (2) "As a result of drinking, how often have you engaged in unplanned sexual activity?".

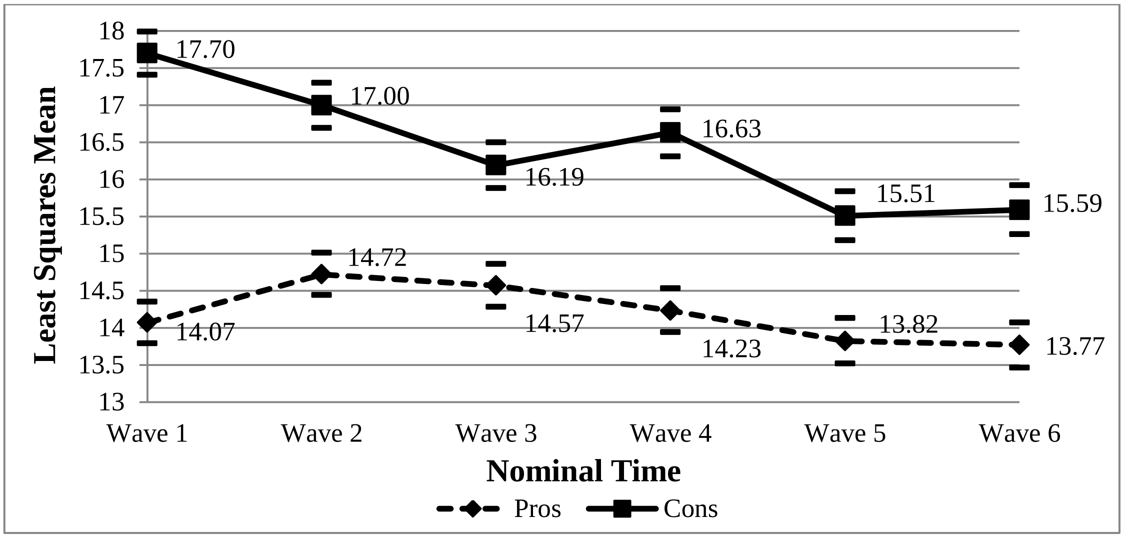
Participants were required to describe "*how often*" their drinking led to any of the listed problems "OVER THE PAST SIX MONTHS" using a 5-point Likert scale that ranged from 0 (Never) to 4 (Very Often). A complete listing of CAPS-r items can be found in Appendix D. These items were summed to create a continuous score that ranged from a low score of 0 to a high score of 32. Participant scores were then used to classify individuals into "Low" ($s = 0$), "Mild" ($s = 1$ to 2), "Moderate" ($s = 3$ to 5) and "High" ($s \geq 6$) subgroups. Similar to the development of peer influence categories, the goal of this classification was to create alcohol problems subgroups that were roughly equivalent in size. At baseline, 23% of students (n = 240) reported no alcohol problems. Combining students with CAPS-r scores of 1 and 2, those with scores 3 to 5, and those with scores greater than or equal to 6 produced the most evenly distributed subgroups. The distribution of students were 23%, 21%, 26% and 30% respectively.

III.E. Time

Data on the dependent measures were collected at 6 time points across a 2-year period with assessments occurring at baseline (0 months), 3, 6, 12, 18 and 24 months post-baseline. Though not the focus of this dissertation, exploratory analyses of unconditional growth involving nominal time (i.e., Wave 1, Wave 2, Wave 3, Wave 4, Wave 5 and Wave 6) were completed. Despite the fact that modelling time in this way assumes equal time intervals between assessments, which inaccurately represents how time is related to growth in alcohol expectancies, doing so allows for the generation of least squares means output that, when plotted, provides a rough estimate of the shape of the growth process for expectancies (Twisk, 2003). As seen in Figure 2, unconditional change in Pros and Cons appear curvilinear with time modeled as a nominal variable.

Figure 2

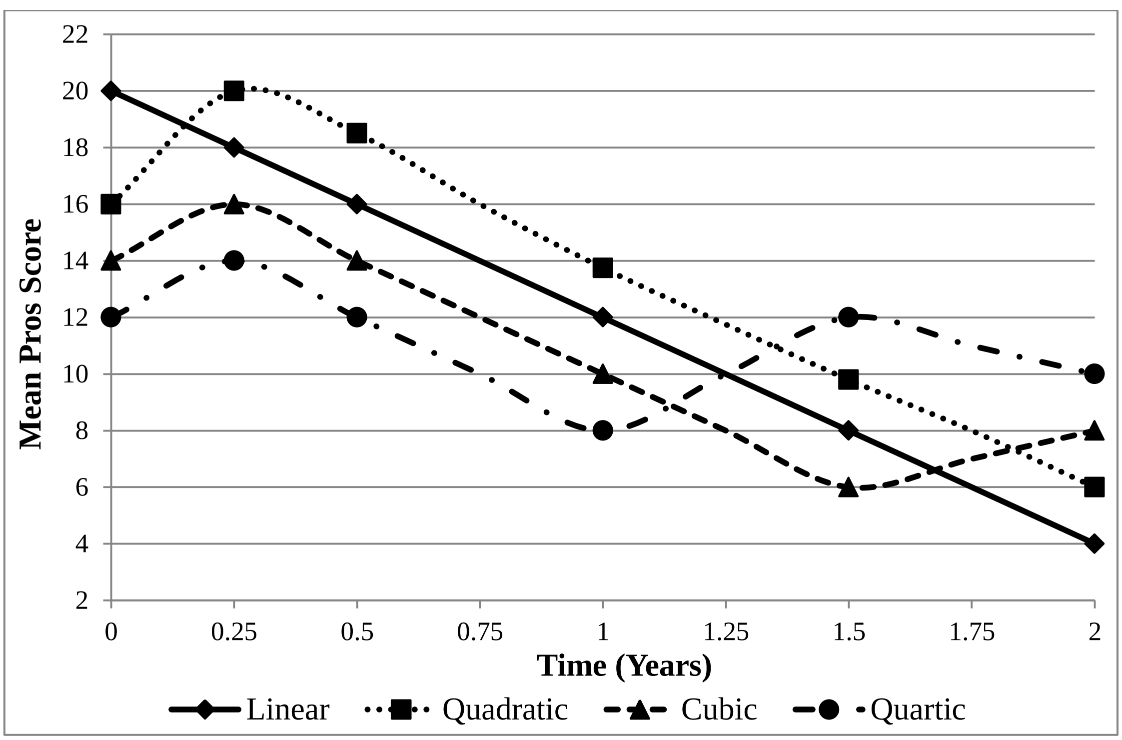
Least squares means for Pros and Cons across nominal time



This observation has implications for tests of unconditional growth in alcohol expectancies involving continuous time models. To minimize convergence problems in the longitudinal models time was re-scaled and expressed as years from baseline (i.e., Baseline=0 years, 3 months=.25 years, 6 months=.5 years, 12 months=1 year, 18 months=1.5 years, and 24 months=2 years). Further, modeling curvilinear change required the transformation of the selected time scale by exponents (square, cubic, and quartic) which increases the magnitude of parameter estimates and the difficulty of interpretation. The conversion from months to years minimizes these problems. Quadratic, cubic and quartic growth functions were created by multiplying linear time (0, .25, .5, 1, 1.5 and 2 years) respectively to the second (0^2, $.25^2$, $.5^2$, 1^2, 1.5^2, 2^2), third (0^3, $.25^3$, $.5^3$, 1^3, 1.5^3, 2^3) and fourth orders of magnitude (0^4, $.25^4$, $.5^4$, 1^4, 1.5^4, 2^4). These curvilinear growth functions are listed as "$time^2$", "$time^3$" and "$time^4$" in the following model building and evaluation section.

Figure 3

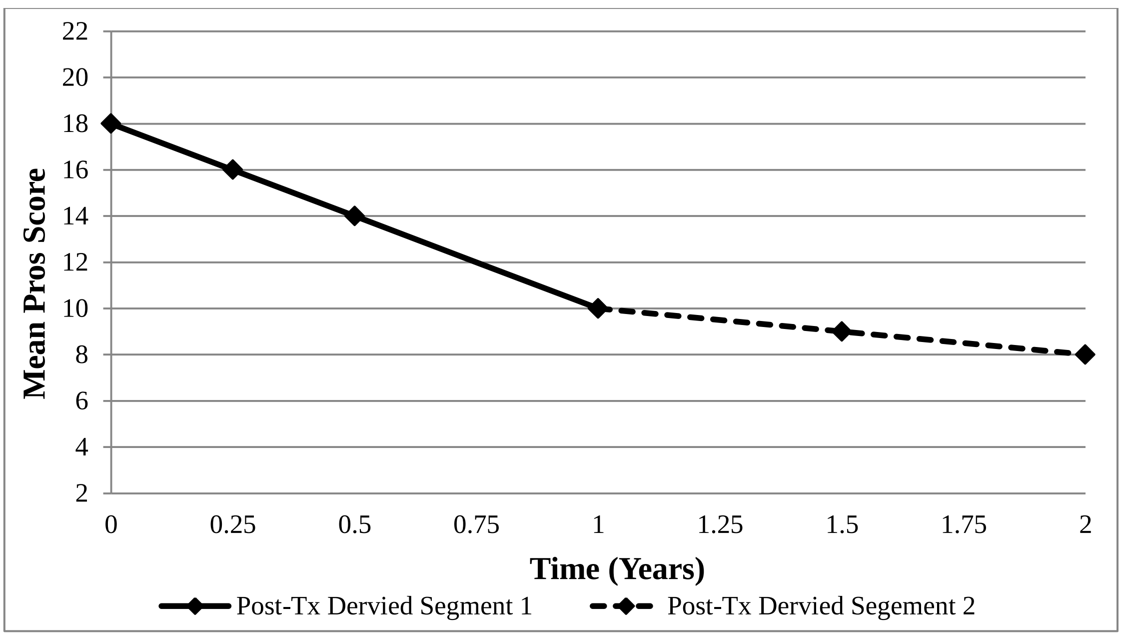
Example of tested growth functions for positive alcohol expectancies



To illustrate, an example of linear, quadratic, cubic and quartic change in mean Pros scores over time is provided in Figure 3. The "Linear" growth depicted in the example suggests that pros will decrease monotonically from baseline to 2 years. By comparison, "Quadratic", "Cubic" and "Quartic" growth are more dynamic. They are made up of peaks (due to increases in pros) and valleys (due to decreases in pros), the most complex being "Quartic" growth. In this example, the shape of "Quartic" growth is defined by increases in pros that occur from baseline to .25 and 1 to 1.5 years and decreases in pros that occur from .25 to 1 year and 1.5 to 2 years.

Figure 4

Example piecewise linear growth functions for positive alcohol expectancies



Note. Tx = treatment.

In the piecewise linear mixed effects regression models, time is treated as two linear growth functions separated by a "knot" of demarcation at the 1-year post-baseline timepoint. As shown in Figure 4, this model depicts growth in two segements. The first segment (Post-Tx Derived Segment 1) spans from 0 to 1 year and is designed to model change in alcohol expectancies due to treatment and its delayed effects. The second segment (Post-Tx Derived Segment 2) spans from 1 to 2 years and is designed to model change in alcohol expectancies that occurs after the treatment period. In the provided example, the rate of reduction in Pros that occurs after 1 year is decreased compared to that which occurs from baseline to 1 year. Piecewise models required the estimation of fewer parameters for time and provided a more parsimonious alternative to modeling curvilinear change in alcohol expectancies.

IV. Statistical Analyses and Procedure

IV.A. Linear Mixed-Effects Regression

This descriptive analytic study involved secondary data analyses of longitudinal data with linear mixed effects regression (LMER) using the Statistical Analysis System (SAS) procedure for mixed modeling (proc mixed). This statistical method is desirable for modeling of longitudinal data for several reasons as noted by Long (2012). First, it can accommodate missing data which is a concern in virtually all longitudinal studies. This is accomplished through full information maximum likelihood (FIML) parameter estimation which uses all available data to estimate model parameters. This method (FIML) corrects for model covariate dependent missingness; that is, it adjusts for any bias due to missingness related to the independent variables included in tested models. Second, it correctly models the dependency in the variance that is due to repeated measures within individuals over time. This is done by explicitly including random effect terms in the model which model the variances and covariances of repeated observations. This is necessary for accurate estimation of standard errors. Third, it can accommodate predictors of change in the dependent measure.

The LMER models tested in this study addressed the proposed research questions through a series of hierarchical model building steps that are described in greater detail in the next section.   This method is designed to arrive at a modelt hat describes the relationship between a dependent variable (positive/negative alcohol expectancies), how it changes over time, and whether or not that change varies with respect to one or more grouping variables (e.g., treatment, gender, binge frequency classification at baseline). The model commonly estimates two sets of components known as fixed- and random-effects. Fixed-effects terms are traditional, group-level linear regression coefficients (β_0, β_1) whereas random-effects are associated with individual variation in initial status (intercept) and change (slope) in the dependent measure over time. When random effects for intercept (b_{0i}) and slope (b_{1i}) are specified in the model the discrepancy between an individual's intercept (b_{0i}) and the group intercept (β_0) and an individual's slope (b_{1i}) and the group slope (β_1) are accounted for (Long, 2012). The standard form of a LMER model equation is expressed as:

$$y_{ij} = \beta_0(1) + \beta_1(\text{time}_j) + b_{0i}(1) + b_{1i} + \varepsilon_{ij}$$

where:

- y_{ij} is the value of the dependent variable for the *i*th individual ($i = 1, \ldots, N$) at time j ($j = 0, .25, .5, 1, 1.5, 2$);
- β_0 is the fixed intercept representing the model estimate of the group value of the dependent variable;
- $\beta_1(\text{time}_j)$ is the fixed slope at time j representing the model estimate of change from the group mean of the dependent variable over time;

- b_{0i} is the random intercept representing individual variation from the fixed intercept (β_0);
- b_{1i} is the random slope representing individual variation from the fixed slope (β_1(time$_j$)); and
- ε_{ij} is the residual error for each *i*th individual at time *j*.

All models contain residual error (ε_{ji}) which is assumed to be normally and independently distributed with a mean of 0 and variance σ^2, expressed as N~(0, σ^2). Also, when included in the model, each random effect (i.e., b_{0i}, b_{1i}, . . . , b_{4i}) is also assumed to be N~(0, σ^2). These assumptions are examined with residual analyses for mixed models (Schutzenmeister & Piepho, 2012).

The model expressed in the aforementioned equation can be expanded on to include the increasingly complex curvilinear growth functions needed to determine if naturalistic change in alcohol expectancies is best modeled with linear, curvilinear or piecewise time. Described in greater detail in the following section, this is accomplished by sequentially adding fixed- (e.g., β_2(time^2_j), . . . , β_4(time^4_j)) and random-effect terms (e.g., b_{1i}, . . . , b_{4i}) for time. Similarly, the addition of moderators of change is accomplished by adding fixed-effect terms for the main effects of specific predictors (e.g., β_4(treatment$_j$)) and their respective interactions with time (e.g., β_5(treatment$_j$*time$_j$)) then sequentially removing fixed-effect terms until only those that contribute to the prediction model remain.

IV.B. Hierarchical Model Building and Selection

IV.B.1. Model Building Procedure to Identify the Functional Form of Positive and Negative Alcohol Expectancies

IV.B.1.a. Continuous, Non-Piecewise Time Models

Borrowing from the LMER hierarchical modeling strategies proposed by Singer and Willet (2003) and Long (2012), a series of increasingly complex models were compared to address the research questions of this study. The first objective was to identify the temporal form of change in college student cognitions of alcohol expectancies. The model building procedure to achieve this objective is illustrated for positive alcohol expectancies (Pros)[3] in Table 6.

Table 6

Sequential models evaluated to identify the temporal form of growth of positive alcohol expectancies (Pros)

No.	Fixed Effects	Random Effects	Model
1.	**Intercept (β_0)**	NA	$Pros_{ij} = \boldsymbol{\beta_0} + \varepsilon_{ij}$
2.	Intercept	**Intercept (b_{0i})**	$Pros_{ij} = \beta_0 + \boldsymbol{b_{0i}} + \varepsilon_{ij}$
3.	Intercept, **Linear Time (β_1(time$_j$))**	Intercept	$Pros_{ij} = \beta_0 + \boldsymbol{\beta_1(time_j)} + b_{0i} + \varepsilon_{ij}$
4.	Intercept, Linear time	Intercept, **Linear Time (b_{1i})**	$Pros_{ij} = \beta_0 + \beta_1(time_j) + (b_{0i} + \boldsymbol{b_{1i}}) + \varepsilon_{ij}$
5.	Intercept, Linear Time, **Quadratic Time (β_2(time^2_j))**	Intercept, Linear Time	$Pros_{ij} = \beta_0 + \beta_1(time_j) + \boldsymbol{\beta_2(time^2_j)} + (b_{0i} + b_{1i}) + \varepsilon_{ij}$
6.	Intercept, Linear Time, Quadratic Time	Intercept, Linear Time, **Quadratic Time (b_{2i})**	$Pros_{ij} = \beta_0 + \beta_1(time_j) + \beta_2(time^2_j) + (b_{0i} + b_{1i} + \boldsymbol{b_{2i}}) + \varepsilon_{ij}$
7.	Intercept, Linear Time, Quadratic Time, **Cubic Time (β_3(time^3_j))**	Intercept, Linear Time, Quadratic Time	$Pros_{ij} = \beta_0 + \beta_1(time_j) + \beta_2(time^2_j) + \boldsymbol{\beta_3(time^3_j)} + (b_{0i} + b_{1i} + b_{2i}) + \varepsilon_{ij}$
8.	Intercept, Linear Time, Quadratic Time, Cubic Time	Intercept, Linear Time, Quadratic Time, **Cubic Time (b_{3i})**	$Pros_{ij} = \beta_0 + \beta_1(time_j) + \beta_2(time^2_j) + \beta_3(time^3_j) + (b_{0i} + b_{1i} + b_{2i} + \boldsymbol{b_{3i}}) + \varepsilon_{ij}$
9.	Intercept, Linear Time, Quadratic Time, Cubic Time, **Quartic Time (β_4(time^4_j))**	Intercept, Linear Time, Quadratic Time, Cubic Time	$Pros_{ij} = \beta_0 + \beta_1(time_j) + \beta_2(time^2_j) + \beta_3(time^3_j) + \boldsymbol{\beta_4(time^4_j)} + (b_{0i} + b_{1i} + b_{2i} + b_{3i}) + \varepsilon_{ij}$
10.	Intercept, Linear Time, Quadratic Time, Cubic Time, Quartic Time	Intercept, Linear Time, Quadratic Time, Cubic Time, **Quartic Time (b_{4i})**	$Pros_{ij} = \beta_0 + \beta_1(time_j) + \beta_2(time^2_j) + \beta_3(time^3_j) + \beta_4(time^4_j) + (b_{0i} + b_{1i} + b_{2i} + b_{3i} + \boldsymbol{b_{4i}}) + \varepsilon_{ij}$

Notes. Hierarchical modeling of unconditional growth in Pros involved the sequential testing of fixed and random effects. Models increase in complexity from step no. 1 to step no. 10. The added parameters within each step are displayed in black font. No. = step number.

[3] The process of modeling unconditional growth in negative alcohol expectancies (cons) is identical to that of positive alcohol expectancies.

Table 6 lists, in sequential order, the nested LMER models that were evaluated. The sequence started with the testing of an intercept-only (β_0) model (see Step 1) and ended with the testing of a model that included fixed-effect terms for the intercept and curvilinear quartic time (β_4(time^4j)) and random-effect terms for the intercept (b_{0i}) and curvilinear quartic time (b_{4i}) (see Step 10). Models were selected by comparison of the model fit criteria discussed below.

The fixed-effect intercept-only (β_0) model tested in Step 1 provided a starting point for the hierarchical modeling procedure. From there, a random-intercept (b_{0i}) was introduced (Step 2) to determine if the addition of a term measuring individual variation from the group mean in Pros scores at baseline improved model fit. Step 3 provided the first instance in which the temporal form of change in positive expectancies was tested. This began by adding a fixed-effect for linear time (β_1(time$_j$) to the prediction model to measure group-level change followed by a test of individual variation in change over time from the estimated group-level change (Step 4). The latter is accomplished by adding a random-effect for linear time (b_{1i}) to the model.

This process of adding fixed-effects to measure group-level change then random-effects to measure individual variation from the group-level change was performed to determine if change in positive expectancies, both at the group and individual levels, was best measured with linear ((β_1(time$_j$), then b_{1i}) or alternative quadratic (β_2(time$^2{}_j$), then b_{2i}), cubic (β_3(time$^3{}_j$), then b_{3i}) and quartic (β_4(time$^4{}_j$), then b_{4i}) slopes. Descriptions of new coefficients beyond the measurement of linear growth at the group and individual levels are summarized below:

- $\beta_2(\text{time}^2_j)$ The fixed quadratic slope, which represents the model estimate of curvilinear quadratic growth in Pros at time *j* for the whole population;
- b_{2i} The random quadratic slope, a measure of individual variation from the estimated fixed quadratic slope. It is the difference in the quadratic slope of Pros for the *i*th individual from the estimated group quadratic slope at each time point *j*;
- $\beta_3(\text{time}^3_j)$ The fixed cubic slope, which represents the model estimate of curvilinear cubic growth in Pros at time *j* for the whole population;
- b_{3i} The random cubic slope, a measure of individual variation from the estimated fixed cubic slope. It is the difference in the cubic slope of Pros for the *i*th individual from the estimated group cubic slope at each time point *j*;
- $\beta_4(\text{time}^4_j)$ The fixed quartic slope, which represents the model estimate of curvilinear quartic growth in Pros at time *j* for the whole population;
- b_{4i} The random quartic slope, a measure of individual variation from the estimated fixed quartic slope. It is the difference in the quartic slope of Pros for the *i*th individual from the estimated group quartic slope at each time point *j*.

The LMER fixed- and random-effect terms and the associated equation that are displayed in Step 10 (see Table 4) best demonstrate the hierarchical or nested nature of this model selection procedure. Working backwards, this final model contains all of the parameters of the model that preceded it (Step 9) plus 1 additional term, a random-effect quartic slope (b_{4i}). Similarly, the model tested in Step 9 contains all of the parameters of the model tested in Step 8 plus 1 additional term, a fixed-effect quartic slope ($\beta_4(\text{time}^4_j)$). As stated in the last section, with each successive step a fixed- or random-effect term is added (noted in **bold** font) to create a model of greater complexity that always includes the lower order terms.

IV.B.1.b. Continuous, Piecewise Models

Piecewise models were tested to determine if change in alcohol expectancies was best measured with 2 linear slopes separated by a "knot" at 1-year post-baseline to account for change that is hypothesized to be due to the CBARR intervention period. These piecewise models are not nested within the previous series of LMER models. They were evaluated separately. The process used for their testing is illustrated in Table 7[4]. The fixed- and random-effect terms described in Steps 1 and 2 are identical to those in Table 6. In Step 3, two fixed-effect terms are added to the model. The first fixed-effect (β_1(time_lt_1_j)) measures linear change in pros at the group level from baseline to 1 year. The second fixed-effect term (β_2(time_gt_1_j)) measures linear change in pros at the group level from 1 to 2 years post-baseline.

The random-effect terms are expressed identically to those presented in the previous series however their interpretation is different. In this series, the first random-effect introduced into the model is b_{1i} (see Step 4 in Table 7). It represents individual variation from the first fixed linear slope (β_1(time_lt_1_j)). It is the difference in the linear slope of pros for the *i*th individual from the estimated group linear slope at each time point *j* from baseline to 1 year. The second random-effect introduced into the model is b_{2i} (Step 5). Similarly, it represents individual variation from the second fixed linear slope (β_2(time_gt_1_j)). It is the difference in the linear slope of pros for the *i*th individual from the estimated group linear slope at each time point *j* from 1 to 2 years post-baseline.

[4] The process once again illustrates the unconditional growth modeling for positive alcohol expectancies.

Table 7

Sequential piecewise models evaluated to identify the temporal form of growth of positive alcohol expectancies (Pros) with 2 linear slopes

No.	Fixed Effects	Random Effects	Model
1.	**Intercept ($\boldsymbol{\beta_0}$)**	NA	$Pros_{ij} = \boldsymbol{\beta_0} + \varepsilon_{ij}$
2.	Intercept	**Intercept ($\boldsymbol{b_{0i}}$)**	$Pros_{ij} = \beta_0 + \boldsymbol{b_{0i}} + \varepsilon_{ij}$
3.	Intercept, **Linear Time 1 ($\boldsymbol{\beta_1}$(time_lt_1$_j$)), Linear Time 2 ($\boldsymbol{\beta_2}$(time_gt_1$_j$))**	Intercept	$Pros_{ij} = \beta_0 + \boldsymbol{\beta_1(time\_lt\_1_j)} + \boldsymbol{\beta_2(time\_gt\_1_j)} + b_{0i} + \varepsilon_{ij}$
4.	Intercept, Linear Time 1, Linear Time 2	Intercept, **Linear Time 1 ($\boldsymbol{b_{1i}}$)**	$Pros_{ij} = \beta_0 + \beta_1(time\_lt\_1_j) + \beta_2(time\_gt\_1_j) + (b_{0i} + \boldsymbol{b_{1i}}) + \varepsilon_{ij}$
5.	Intercept, Linear Time 1, Linear Time 2	Intercept, Linear Time 1, **Linear Time 2 ($\boldsymbol{b_{2i}}$)**	$Pros_{ij} = \beta_0 + \beta_1(time\_lt\_1_j) + \beta_2(time\_gt\_1_j) + (b_{0i} + b_{1i} + \boldsymbol{b_{2i}}) + \varepsilon_{ij}$

Notes. Hierarchical modeling of unconditional piecewise growth in Pros involved the sequential testing of fixed and random effects. Fixed-effect linear slopes for the first and second segments are added in a single step (Step 3). Models increase in complexity from step no. 1 to step no. 5. The added parameters within each step are displayed in black font. No. = step number.

The testing of piecewise LMER growth models concluded the tests of unconditional growth to determine the temporal process for change in college student cognitions of alcohol expectancies over time. Within each series the best model explaining group and individual change in alcohol expectancies was selected as a potential candidate for modeling conditional growth. These models were evaluated in a side-by-side comparison of model fit criteria described in the following section.

IV.B.1.c. Model Selection Procedure to Identify the Functional Form of Positive and Negative Alcohol Expectancies

Several model fit statistics were compared to determine the functional form of change in alcohol expectancies. First, the log likelihood ratio test (LLRT), a preferred measure of model fit for Null Hypothesis Significant Testing (NHST), was calculated for nested models (i.e., the continuous, non-piecewise and piecewise models just decribed). This was done by subtracting the -2 log likelihood of a more complex, full model from a less complex nested model and taking the difference of their respective degrees of freedom (*df*) for number of estimated parameters. The LLRT follows the chi-square distribution with $df_{\text{full}} - df_{\text{reduced}}$ degrees of freedom. The advantage of this model fit statistic is that it allows for model assessment in terms of statistical significance and *a priori* Type I error rate (Long, 2012). If the calculated LLRT is greater than the chi-square value at the calculated difference of *df* and at the selected *a priori* alpha level, evidence of statistically significant improvement in model fit exists and the better-fitting model can be identified.

In addition to the LLRT, models were compared using the Akaike Information Criterion (AIC; Akaike, 1973), Akaike Information Criterion-Corrected (AICC; Hurvich & Tsai, 1989), and Bayesian Information Criterion (BIC; Schwarz, 1978). These measures of model fit are derived from the log-likelihood statistic and are widely used by researchers to assess improvement in predictive accuracy of non-nested models. The AIC, AICC and BIC are derived from and penalize the deviance function. Specifically, the AIC penalizes deviance by 2 times the number of estimated parameters to control for improvement in model fit that occurs by simply adding terms to the model (Long, 2012). The AICC takes this one step further by adjusting for finite sample sizes. The BIC is very similar to AIC in that it introduces a penalty, albeit a larger one, on the estimated number of parameters (Schwarz, 1978). There are no statistical distributions for these measures. Generally, smaller values are indicative of better model fit.

It should be noted that, because of the large sample size, statistically significant differences in LLRT found between nested models may not be of much practical importance. In cases where the LLRT indicated small or moderate but statistically significant improvement in fit, the model selection procedure favored the smaller model (most parsimonious), and/or models with the most consistency among AIC, AICC and BIC estimates. Further, a 5% rule for reductions in residual error (MSE) from smaller to larger models was used as an additional measure of improvement in model fit.

IV.B.2. Model Building and Selection Procedure to Determine Predictors of Change in Positive and Negative Alcohol Expectancies

After identifying the temporal processes for change in positive and negative alcohol expectancies it was possible to move on to tests of conditional growth to determine if change in expectancies was moderated by treatment and the selected demographic, social, family history, alcohol and other drug use variables. As with the previous tests of unconditional growth, tests of conditional growth involved hierarchical modeling. There is one primary difference. The hierarchical modeling of conditional growth with two-way interaction effects starts with the most complex model and proceeds by sequentially removing fixed-effect terms until only those that contribute to the prediction model remain. This is described by Long (2012) as a “top-down” approach where the interaction between a moderator and a selected group-level growth function, whether linear or curvilinear, is of the utmost importance. When higher order interaction effects where determined to not be significant ($p \geq .10$) through type III tests of fixed-effects, they were removed from the model until a lower order significant moderator by time interaction was found or, alternatively, only the main effect of the moderator remained. If the main effect for the moderator was also found to not be significant ($p \geq .05$) it too was removed from the prediction model.

This process is illustrated for positive alcohol expectancies (pros) and treatment condition in Table 8.

Table 8

Model building sequence for the evaluation of conditional growth in positive alcohol expectancies: Example Treatment effects

No.	Fixed Effects	Random Effects	Model
0	Intercept, Linear Time, Quadratic Time	Intercept, Linear Time, Quadratic Time	$\text{Pros}_{ij} = \beta_0 + \beta_1(\text{time}_j) + \beta_2(\text{time}^2_j) + (b_{0i} + b_{1i} + b_{2i}) + \varepsilon_{ij}$
1	Intercept, Linear Time, Quadratic Time, **Treatment ($\boldsymbol{\beta_3}$(treatment$_j$)), Treatment*Linear Time (($\boldsymbol{\beta_4}$(treatment$_j$*time$_j$)), Treatment*Quadratic Time (($\boldsymbol{\beta_5}$(treatment$_j$*time^2_j))**	Intercept, Linear Time, Quadratic Time	$\text{Pros}_{ij} = \beta_0 + \beta_1(\text{time}_j) + \beta_2(\text{time}^2_j)$ **+ $\boldsymbol{\beta_3(\text{treatment}_j)}$ + $\boldsymbol{\beta_4(\text{treatment}_j*\text{time}_j)}$ + $\boldsymbol{\beta_5(\text{treatment}_j*\text{time}^2_j)}$ +** $(b_{0i} + b_{1i} + b_{2i}) + \varepsilon_{ij}$
2	Intercept, Linear Time, Quadratic Time, Treatment Treatment*Linear Time ~~**Treatment*Quadratic Time**~~	Intercept, Linear Time, Quadratic Time	$\text{Pros}_{ij} = \beta_0 + \beta_1(\text{time}_j) + \beta_2(\text{time}^2_j) + \beta_3(\text{treatment}_j) + \beta_4(\text{treatment}_j*\text{time}_j) +$ ~~**$\boldsymbol{\beta_5(\text{treatment}_j*\text{time}^2_j)}$**~~ **+** $(b_{0i} + b_{1i} + b_{2i}) + \varepsilon_{ij}$

Notes. Hierarchical modeling of conditional growth in Pros involved a "top down" evaluation of fixed effects. In this example, the best fitting unconditional model, which models group and individual level change in Pros with quadratic time, served as the base model for tests of conditional growth (Step 0). In Step 1, the highest order predictor X time interaction terms (and all lower terms) are added. Fixed-effects that are determined to be non-significant are removed until only the significant fixed-effects remain. Here, the highest order treatment X quadratic time interaction effect is not significant (noted in bold strikethrough) and removed from the model (Step 2). Added/subtracted parameters within each step are displayed in black font. No. = step number.

In the example used to illustrate this method it is assumed that group- and individual-level change in pros is best modeled with quadratic time (see Step 0 in Table 8). In Step 1, using this model as a base, a fixed main effect for treatment condition (β_3(treatment$_j$)) and fixed interaction effects between treatment condition and linear time (β_4(treatment$_j$*time$_j$)) and treatment condition and quadratic time (β_5(treatment$_j$*time^2_j)) were added (see **bold** font terms expressed in Step 1). Here, emphasis is on the highest order treatment by quadratic time interaction effect which tests whether change in pros measured with a curvilinear, quadratic function varied by treatment condition. The fixed main effect for treatment condition and fixed interaction effect for treatment condition by linear time must be included in the model because they are the lower order terms.

In Step 2 of this example the fixed treatment by quadratic time interaction effect was not significant at the .10 *a priori* alpha level, so it was removed from the model (noted in ~~**bold strikethrough**~~ in Step 2). Now the highest order fixed-effect is a statistically significant treatment by linear time interaction. The interpretation of this result would be that group-level change in Pros measured with linear time varies by treatment condition. Each predictor was evaluated using this same model building procedure. Conditional LMER analyses involving demographic, social, parent, alcohol-related and other substance use factors controlled for treatment effects. Once identified, predictors that had significant main or interaction effects with time were combined into a full model and tested using the "top down" approach. Fixed effect estimates for the final full model were tabulated for all significant interactions and lesser main effects identified through type III tests of fixed effects.

IV.B.3. Model Building and Selection Procedure to Determine if Predictors Moderated the Effects of Treatment on Positive and Negative Alcohol Expectancies

This study concluded with the testing of a series of hierarchical LMER models that included three-way interaction effects to determine if the effects of treatment were moderated by selected predictors. This was accomplished using the hierarchical modeling and selection procedures just described. In the previous example, a significant treatment condition by fixed linear time interaction effect was found

(β_4(treatment$_j$*time$_j$)). Now assume that a test of gender as a moderator of change in pros resulted in a significant gender by fixed linear time interaction effect (β_6(male$_j$*time$_j$)). These two significant, two-way interactions with fixed linear time would then be incorporated into one model with the highest order term being a three-way interaction between treatment, gender and linear time.

Table 9

Model building sequence for the evaluation of conditional growth in positive alcohol expectancies: Example Treatment by Gender effects

No.	Fixed Effects	Random Effects	Model
1	Intercept, Linear Time, Quadratic Time, Treatment Treatment*Linear Time **Male (β_5(male$_j$)),** **Male*Linear Time** **(β_6(male$_j$*time$_j$)),** **Treatment*Male** **(β_7(male$_j$*time$_j$)),** **Treatment*Male*Linear Time, (β_8(treatment$_j$* male$_j$*time$_j$))**	Intercept, Linear Time, Quadratic Time	Pros$_{ij}$ = β_0 + β_1(time$_j$) + β_2(time^2_j) + β_3(treatment$_j$) + β_4(treatment$_j$*time$_j$) **+** **β_5(male$_j$)** **+ β_6(male$_j$*time$_j$)** **+ β_7(treatment$_j$*male$_j$)** **+ β_8(treatment$_j$*male$_j$* time$_j$)** + (b_{0i} + b_{1i} + b_{2i}) + ε_{ij}
2	Intercept, Linear Time, Quadratic Time, Treatment, Treatment*Linear Time, Male, Male*Linear Time, Treatment*Male ~~**Treatment*Male*Linear Time**~~	Intercept, Linear Time, Quadratic Time	Pros$_{ij}$ = β_0 + β_1(time$_j$) + β_2(time^2_j) + β_3(treatment$_j$) + β_4(treatment$_j$*time$_j$) + β_5(male$_j$) + β_6(male$_j$*time$_j$) + β_7(treatment$_j$*male$_j$) + ~~**β_8(treatment$_j$* male$_j$* time$_j$)**~~ ~~+~~ (b_{0i} + b_{1i} + b_{2i}) + ε_{ij}
3	Intercept, Linear Time, Quadratic Time, Treatment, Treatment*Linear Time, Male, **Male*Linear Time,** ~~**Treatment*Male,**~~ ~~**Treatment*Male*Linear Time**~~	Intercept, Linear Time, Quadratic Time	Pros$_{ij}$ = β_0 + β_1(time$_j$) + β_2(time^2_j) + β_3(treatment$_j$) + β_4(treatment$_j$*time$_j$) + β_5(male$_j$) + β_6(male$_j$*time$_j$) ~~**+ β_7(treatment$_j$*male$_j$)**~~ ~~**+ β_8(treatment$_j$* male$_j$* time$_j$)**~~ + (b_{0i} + b_{1i} + b_{2i}) + ε_{ij}

Notes. Tests of conditional growth to determine if the predictors moderated the effects of treatment on change in alcohol expectancies involved a “top down” evaluation of fixed effects. These tests start with the most complex model which includes a three-way treatment X gender X linear time interaction and all lower order terms (Step 1). Fixed-effects that are determined to be non-significant are removed until only the significant fixed-effects remain. No. = step number.

This test would address the question of whether treatment effects differed by gender over time. This process is illustrated for Pros in Table 9. In Step 1 the fixed effect for the three-way interaction between treatment condition, gender and linear time (β_8(treatment$_j$*male$_j$* time$_j$)) is the highest order term of interest. Along with the three-way interaction effect, new to this model are the fixed main effect for gender (β_5(male$_j$)) and the fixed two-way interaction effects between gender and linear time (β_6(male$_j$*time$_j$)) and treatment and gender (β_7(treatment$_j$* male$_j$)). In this example, the three-way interaction effect was not significant at the .10 *a priori* alpha level. Once removed, the model was tested a second time with the highest order fixed-effect of interest being the two-way interaction between treatment and gender (see Step 2). This effect is also found to not be significant and would lead to the conclusion that the effect of treatment on change in pros is not moderated by gender.

IV. Summary

This chapter detailed the methods used to examine predictors of change in college student cognitions of positive and negative alcohol expectancies. This chapter started with a description of the longitudinal data set, gathered as part of the CBARR study, the operationalization of dependent measures, which are positive and negative alcohol expectancies, and the operationalization of the selected predictors which include treatment condition, gender, race, peer influences, Greek status, binge frequency, alcohol-related problems, parent alcoholism, cigarette and marijuana smoking statuses, and time. From there, the data analytic strategy was presented. This included information on the selected statistical analysis (LMER), the procedure for selection of nested and non-nested models, assessing model fit and determining the shape of change in positive and negative alcohol expectancies, and the procedure used to identify meaningful moderators of that change. In the following chapter (Chapter 3) the results of this study are presented. Results specific to unconditional change in positive and negative alcohol expectancies are presented first, followed by those specific to conditional change. Significant findings are emphasized.

CHAPTER 3

FINDINGS

I. Overview

Growth in positive (Pros) and negative (Cons) alcohol expectancies was examined in three stages. First, a series of increasingly complex nested models were tested to determine the shape of change in alcohol expectancies over time. Continuous linear, higher order curvilinear (quadratic, cubic, or quartic) and piecewise growth models were tested. The piecewise growth models were evaluated after models testing continuous growth. Second, a series of increasingly complex models conditional on treatment were evaluated. This analysis was followed by similar models testing the conditional effects of gender, race, class year, Greek status, peer influence, parent alcoholism, binge frequency, alcohol-related problems and cigarette and marijuana use whilte controlling for treatment effects. Lastly, analyses of three-way interaction effects of each of the significant predictors conditional on time and treatement were examined. Indices of model fit and NHST for nested models served as criteria for model selection. The fixed-effect results of the best fitting multiple variable model are described.

II.A. Unconditional Growth in Positive and Negative Alcohol Expectancies

Table 10 summarizes the fit statistics associated with the mixed models for Pros where the temporal process for change in positive alcohol expectancies at the group and individual levels is modeled with continuous linear, quadratic, cubic and quartic

Table 10

Unconditional model fit statistics for positive alcohol expectancies (Pros)

No.	Model Parameters	MSE	-2 LL	AIC	AICC	BIC	K	*df*	LLRT
1a	FE: β_0	21.50	30072.6	30076.6	30076.6	30089.7	2	--	--
1b	FE: β_0 RE: b_{0i}	7.19	26993.1	26999.1	26999.1	27014.0	3	1	-3080^{***}
1c	FE: β_0, $\beta_1(\text{time}_j)$ RE: b_{0i}	7.23	26959.5	26967.5	26967.5	26987.4	4	1	-34^{***}
1d	FE: β_0, $\beta_1(\text{time}_j)$ RE: b_{0i}, b_{1i}	6.37	26868.8	26880.8	26880.8	26910.6	6	2	-91^{***}
1e	FE: β_0, $\beta_1(\text{time}_j)$, $\beta_2(\text{time}^2_j)$ RE: b_{0i}, b_{1i}	6.34	26852.6	26866.6	26866.6	26901.4	7	1	-16^{***}
1f	FE: β_0, $\beta_1(\text{time}_j)$, $\beta_2(\text{time}^2_j)$ RE: b_{0i}, b_{1i}, b_{2i}	6.07	26821.7	26841.7	26841.8	26891.4	10	3	-31^{***}
1g	FE: β_0, $\beta_1(\text{time}_j)$, $\beta_2(\text{time}^2_j)$, $\beta_2(\text{time}^3_j)$ RE: b_{0i}, b_{1i}, b_{2i}	6.00	26789.6	26811.6	26811.7	26866.3	11	1	-32^{***}
1h	**FE: β_0, $\beta_1(\text{time}_j)$, $\beta_2(\text{time}^2_j)$, $\beta_2(\text{time}^3_j)$ RE: b_{0i}, b_{1i}, b_{2i}, b_{3i}**	**5.68**	**26758.8**	**26788.8**	**26788.9**	**26863.4**	**15**	**4**	$\mathbf{-31^{***}}$
1i	FE: β_0, $\beta_1(\text{time}_j)$, $\beta_2(\text{time}^2_j)$, $\beta_2(\text{time}^3_j)$, $\beta_2(\text{time}^4_j)$ RE: b_{0i}, b_{1i}, b_{2i}, b_{3i}	5.66	26754.5	26786.5	26786.6	26866.1	16	1	-4^{*}
1j	FE: β_0, $\beta_1(\text{time}_j)$, $\beta_2(\text{time}^2_j)$, $\beta_2(\text{time}^3_j)$, $\beta_2(\text{time}^4_j)$ RE: b_{0i}, b_{1i}, b_{2i}, b_{3i}, b_{4i}	5.40	26738.0	26780.0	26780.2	26884.8	21	5	-17^{**}

Notes. The *df* is the difference in number of estimated parameters (K) from a reduced to next highest full model. Similarly, the LLRT is the difference in -2 LL from a reduced to the next highest full model. Model improvement is evaluated on a chi-square distribution (LLRT) at calculated *df* and a .05 *a priori* significance level, by reductions in model fit indices (AIC, AICC, BIC), 5% reductions in residual error (MSE), and the rule of parsimony. The best fitting model is displayed in bold font. No.=Number, FE=Fixed Effects RE=Random Effects, MSE=Mean Square Error, -2 LL= -2 Log Likelihood, AIC = Akaike Information Criterion, AICC = Akaike Information Criterion – Corrected, BIC = Bayesian Information Criterion, K=No. of Estimated Parameters, *df*=degrees of freedom, LLRT = Log Likelihood Ratio Test
*****$p < .05$; ******$p < .01$; *******$p < .001$

growth functions. Fit estimates are provided for comparison of the models. Statistically significant improvement in model fit was achieved with each successive model (see Log Likelihood Ratio Test (LLRT) from model numbers 1b – 1j; Table 10), the largest occurring with the addition of a random intercept (b_{0i}) to the fixed intercept-only (β_0) model ($x^2(1) = -3080$, $p < .001$). This demonstrates the importance of using mixed models to statistically account for individual level dependence of the observations.

A review of likelihood deviance function (-2 LL), Akaike Information Criterion (AIC), Akaike Information Criterion-Corrected (AICC) and Bayesian Information Criterion (BIC) fit statistics, with the exception of models testing quartic change in pros at the group (Model 1i) and individual (Model 1j) levels, support successive model improvement. The addition of a fixed-effect term for quartic growth ($\beta_2(\text{time}^4_j)$) provided the first instance in which the addition of a higher order term did not result in consistently lower fit statistics (Note: the BIC=268661.1 associated with Model 1i is larger than the BIC=26863.4 associated with Model 1h). This result indicated that Model 1h, which modeled group and individual level change in Pros with curvilinear cubic growth functions, best fit the data. Model 1h also produced a 5% reduction in residual error (MSE) from Model 1g ((6.00 - 5.68)/6.00 = .053).

Improvement in model fit, measured with LLRT, was not achieved with each successive model measuring unconditional growth in Cons. As shown in Table 11, the higher AIC, AICC and BIC values associated with Model 2j, in addition to the non-significant LLRT, indicated that the most complex model, which modeled group ($\beta_2(\text{time}^4_j)$) and individual level (b_{4i}) change with a quartic growth function, did not

Table 11

Unconditional model fit statistics for negative alcohol expectancies (Cons)

No.	Model Parameters	MSE	-2 LL	AIC	AICC	BIC	K	*df*	LLRT
2a	FE: β_0	24.26	30712.3	30716.3	30716.3	30729.4	2	--	--
2b	FE: β_0 RE: b_{0i}	11.39	28748.1	28752.1	28752.1	28762.0	3	1	-1964***
2c	FE: β_0, β_1(time$_j$) RE: b_{0i}	10.82	28540.3	28548.3	28548.3	28568.2	4	1	-209***
2d	FE: β_0, β_1(time$_j$) RE: b_{0i}, b_{1i}	9.72	28464.8	28476.8	28476.8	28506.7	6	2	-76***
2e	FE: β_0, β_1(time$_j$), β_2(time^2_j) RE: b_{0i}, b_{1i}	9.66	28446.9	28460.9	28460.9	28495.7	7	1	-18***
2f	FE: β_0, β_1(time$_j$), β_2(time^2_j) RE: b_{0i}, b_{1i}, b_{2i}	9.30	28407.7	28427.7	28427.7	28477.4	10	3	-39***
2g	FE: β_0, β_1(time$_j$), β_2(time^2_j), β_2(time^3_j) RE: b_{0i}, b_{1i}, b_{2i}	9.27	28399.6	28421.6	28421.6	28476.3	11	1	-8**
2h	FE: β_0, β_1(time$_j$), β_2(time^2_j), β_2(time^3_j) RE: b_{0i}, b_{1i}, b_{2i}, b_{3i}	8.95	28370.2	28400.2	28400.3	28474.8	15	4	-29***
2i	**FE: β_0, β_1(time$_j$), β_2(time^2_j), β_2(time^3_j), β_2(time^4_j) RE: b_{0i}, b_{1i}, b_{2i}, b_{3i}**	**8.80**	**28341.9**	**28373.9**	**28374.0**	**28453.4**	**16**	**1**	**-28*****
2j	FE: β_0, β_1(time$_j$), β_2(time^2_j), β_2(time^3_j), β_2(time^4_j) RE: b_{0i}, b_{1i}, b_{2i}, b_{3i}, b_{4i}	8.15	28332.6	28374.6	28374.8	28479.0	21	5	-9

Notes. The *df* is the difference in number of estimated parameters (K) from a reduced to next highest full model. Similarly, the LLRT is the difference in -2 LL from a reduced to the next highest full model. Model improvement is evaluated on a chi-square distribution (LLRT) at calculated *df* and a .05 *a priori* significance level, by reductions in model fit indices (AIC, AICC, BIC), 5% reductions in residual error (MSE), and the rule of parsimony. The best fitting model is displayed in bold font. No.=Number, FE=Fixed Effects RE=Random Effects, MSE=Mean Square Error, -2 LL= -2 Log Likelihood, AIC = Akaike Information Criterion, AICC = Akaike Information Criterion – Corrected, BIC = Bayesian Information Criterion, K=No. of Estimated Parameters, *df*=degrees of freedom, LLRT = Log Likelihood Ratio Test
*****$p < .05$; ******$p < .01$; *******$p < .001$

best fit the data. Within this series the best fitting model is Model 2i. With the exception of a reduction in MSE that was not $\geq$ 5% from the previous nested model

((8.95 – 8.80)/8.95 = .02), all fit statistics, even the rule of parsimony, indicated that group level change in negative alcohol expectancies was best modeled with a curvilinear quartic growth function while individual level change is best modeled with cubic time (b_{3i}).

II.B. Unconditional Piecewise Growth in Positive and Negative Alcohol Expectancies

Results of tests of unconditional piecewise growth for Pros are summarized in Table 12. Fit statistics indicate that Model 3e, which included two random slope terms modeling change from baseline to 1 year (b_{1i}) and 1 to 2 years (b_{2i}) best fit the data. This is shown by the statistically significant reduction in LLRT ($x^2(3) = -26$, $p <$

Table 12

Unconditional piecewise model fit statistics for positive alcohol expectancies (Pros)

No.	Model Parameters	MSE	-2 LL	AIC	AICC	BIC	K	*df*	LLRT
3a	FE: β_0	21.50	30072.6	30076.6	30076.6	30089.7	2	--	--
3b	FE: β_0 RE: b_{0i}	7.19	26993.1	26999.1	26999.1	27014.0	3	1	-3080^{***}
3c	FE: β_0, β_1(time_lt_1$_j$), β_1(time_gt_1$_j$), RE: b_{0i}	7.22	26950.8	26960.8	26960.8	26985.6	5	2	-42^{***}
3d	FE: β_0, β_1(time_lt_1$_j$), β_1(time_gt_1$_j$), RE: b_{0i}, b_{1i}	6.34	26862.0	26876.0	26876.0	26910.8	7	2	-89^{***}
3e	**FE: β_0, β_1(time_lt_1$_j$), β_1(time_gt_1$_j$), RE: b_{0i}, b_{1i}, b_{2i}**	**6.20**	**26836.0**	**26856.0**	**26856.0**	**26905.7**	**10**	**3**	**-26^{***}**

Notes. The *df* is the difference in number of estimated parameters (K) from a reduced to next highest full model. Similarly, the LLRT is the difference in -2 LL from a reduced to the next highest full model. Model improvement is evaluated on a chi-square distribution (LLRT) at calculated *df* and a .05 *a priori* significance level, by reductions in model fit indices (AIC, AICC, BIC), 5% reductions in residual error (MSE), and the rule of parsimony. The best fitting model is displayed in bold font. No.=Number, FE=Fixed Effects RE=Random Effects, MSE=Mean Square Error, -2 LL= -2 Log Likelihood, AIC = Akaike Information Criterion, AICC = Akaike Information Criterion – Corrected, BIC = Bayesian Information Criterion, K=No. of Estimated Parameters, *df*=degrees of freedom, LLRT = Log Likelihood Ratio Test
*****$p < .05$; ******$p < .01$; *******$p < .001$

.001), lower AIC, AICC and BIC values and lower MSE.

For Cons, Model 4d, which included one random-effect term that modeled linear individual variation in change from baseline to 1-year, best modeled change in negative alcohol expectancies (see Table 13). Note the statistically significant reduction in LLRT ($x^2(2) = -104$, $p < .001$) from Models 4c to 4d, lower AIC, AICC, and BIC values and 13% reduction in MSE ((10.81 – 9.43)/10.81 = .13). The addition of a second random-effect term modeling linear, individual variation in change from 1 to 2 years did not result in significant improvement.

Table 13

Unconditional piecewise model fit statistics for negative alcohol expectancies (Cons)

No.	Model Parameters	MSE	-2 LL	AIC	AICC	BIC	K	*df*	LLRT
4a	FE: β_0	24.26	30712.3	30716.3	30716.3	30729.4	2	--	--
4b	FE: β_0 RE: b_{0i}	11.39	28748.1	28752.1	28752.1	28762.0	3	1	-1964^{***}
4c	FE: β_0, β_1(time_lt_1_j), β_1(time_gt_1_j), RE: b_{0i}	10.81	28536.6	28546.6	28546.6	28571.5	5	2	-211^{***}
4d	**FE: β_0, β_1(time_lt_1_j), β_1(time_gt_1_j), RE: b_{0i}, b_{1i}**	**9.43**	**28432.8**	**28446.8**	**28446.8**	**28481.6**	**7**	**2**	**-104^{***}**
4e	FE: β_0, β_1(time_lt_1_j), β_1(time_gt_1_j), RE: b_{0i}, b_{1i}, b_{2i}	9.44	28430.9	28448.9	28449.0	28493.7	10	3	-2

Notes. The *df* is the difference in number of estimated parameters (K) from a reduced to next highest full model. Similarly, the LLRT is the difference in -2 LL from a reduced to the next highest full model. Model improvement is evaluated on a chi-square distribution (LLRT) at calculated *df* and a .05 *a priori* significance level, by reductions in model fit indices (AIC, AICC, BIC), 5% reductions in residual error (MSE), and the rule of parsimony. The best fitting model is displayed in bold font. No.=Number, FE=Fixed Effects RE=Random Effects, MSE=Mean Square Error, -2 LL= -2 Log Likelihood, AIC = Akaike Information Criterion, AICC = Akaike Information Criterion – Corrected, BIC = Bayesian Information Criterion, K=No. of Estimated Parameters, *df*=degrees of freedom, LLRT = Log Likelihood Ratio Test
*****$p < .05$; ******$p < .01$; *******$p < .001$

II.C. Comparison of Continuous and Piecewise Unconditional Growth Models to Identify Base Models for Conditional Growth in Pros and Cons

In summary, the tests of unconditional growth in Pros and Cons produced two "best fitting" candidate models for each dependent measure. Table 14 summarizes the fit statistics for the selected continuous and piecewise models identified as the best fitting for positive and negative alcohol expectancies. Given that these models are not nested, LLRT cannot be used to determine which models should be used as the base models for tests of conditional growth.

Table 14

Comparison of modelf fit statistics for candidate unconditional growth models for Pros (Top) and Cons (Bottom)

No.	Description	Model Parameters	MSE	-2 LL	AIC	AICC	BIC	K
			Pros					
1h	**Continuous**	**FE: β_0, β_1(time$_j$), β_2(time$^2{}_j$), β_2(time$^3{}_j$)** **RE: b_{0i}, b_{1i}, b_{2i}, b_{3i}**	**5.68**	**26758.8**	**26788.8**	**26788.9**	**26863.4**	**15**
3e	Piecewise	FE: β_0, β_1(time_lt_1$_j$), β_1(time_gt_1$_j$), RE: b_{0i}, b_{1i}, b_{2i}	6.20	26836.0	26856.0	26856.0	26905.7	10
			Cons					
2i	**Continuous**	**FE: β_0, β_1(time$_j$), β_2(time$^2{}_j$), β_2(time$^3{}_j$), β_2(time$^4{}_j$)** **RE: b_{0i}, b_{1i}, b_{2i}, b_{3i}**	**8.80**	**28341.9**	**28373.9**	**28374.0**	**28453.4**	**16**
4d	Piecewise	FE: β_0, β_1(time_lt_1$_j$), β_1(time_gt_1$_j$), RE: b_{0i}, b_{1i}	9.43	28432.8	28446.8	28446.8	28481.6	7

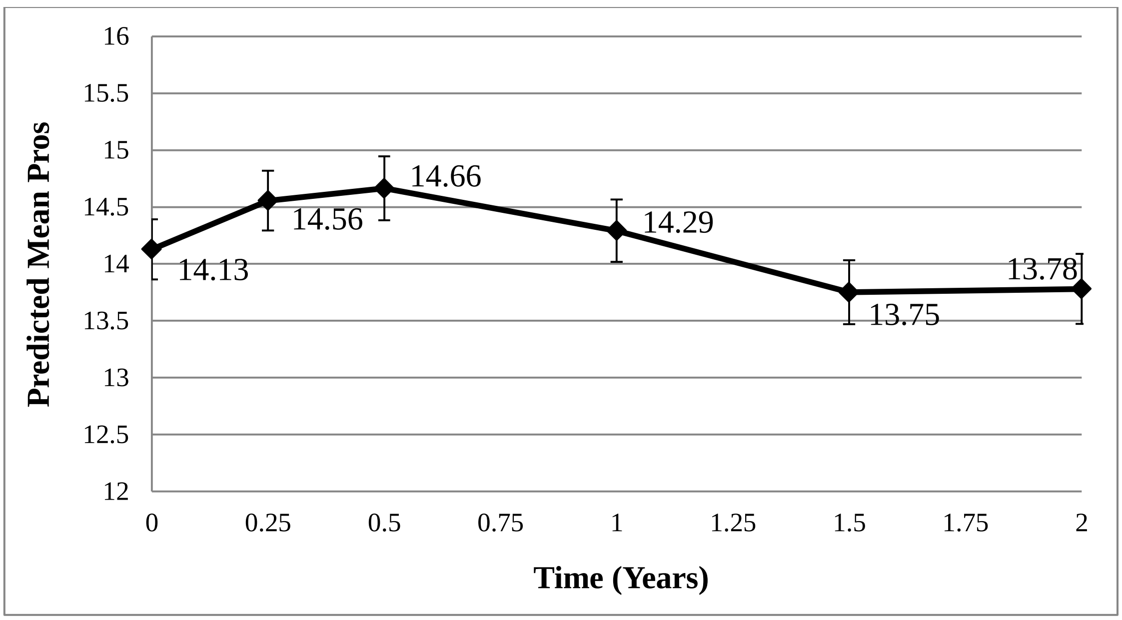
Notes. The best fitting models for Pros and Cons are displayed in bold font. These models served as base models for tests of conditional growth in positive and negative alcohol expectancies. No.=Number, FE=Fixed Effects RE=Random Effects, MSE=Mean Square Error, -2 LL= -2 Log Likelihood, AIC = Akaike Information Criterion, AICC = Akaike Information Criterion – Corrected, BIC = Bayesian Information Criterion, K=No. of Estimated Parameters.

Review of the remaining model fit statistics provided that Model 1h, the continuous model that measured curvilinear change in Pros at the group and individual levels with cubic growth functions, fit the data better than the piecewise model (Model

3e). Though more parameters are estimated by this model making it the least parsimonious of the two, the -2 LL, AIC, AICC and BIC values are preferred as is the lower MSE. The same can be stated for the non-piecewise, continuous unconditional growth model for cons where group level change is measured with a quartic growth function and individual variation from that change is best modeled with cubic time (Model 2i).

Figure 5

Predicted means and 95% CIs from unconditional growth in Pros model

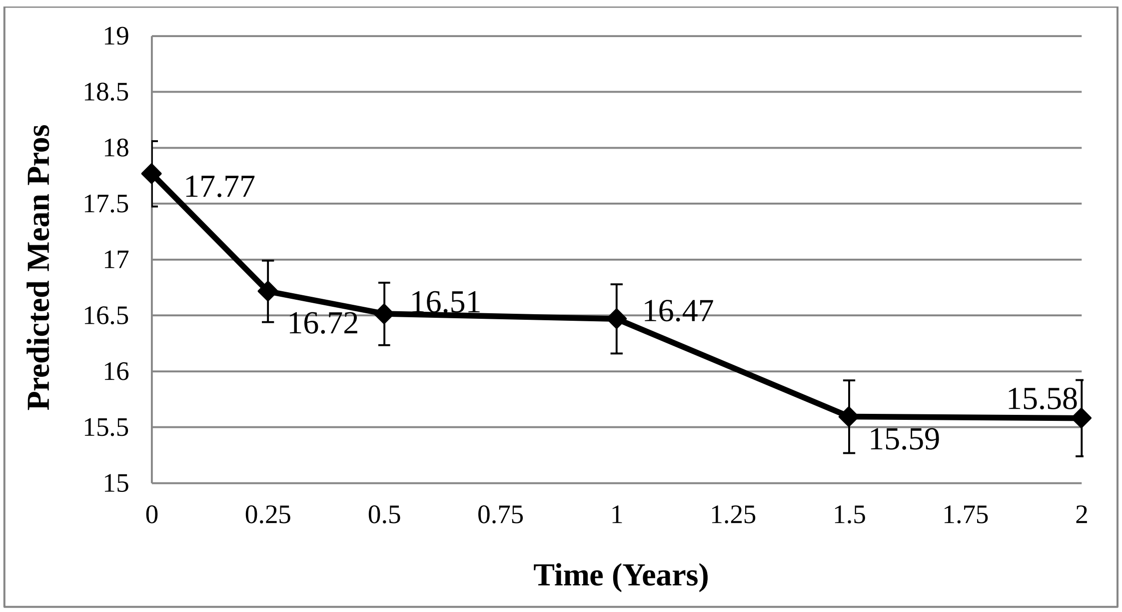


Models 1h and 2i indicate that group-level change, not accounting for predictor effects, in positive and negative alcohol expectancies over time is curvilinear. This can be visualized in Figures 5 and 6 where predicted group means with 95% Confidence Intervals (CIs) for Pros and Cons over time are plotted. In partial support of the first hypothesis (H1: Positive alcohol expectancies will increase initially then experience a reduction over time), at the group level, Pros were observed to increase slightly from baseline to .5 years (6 months) then decrease gradually from .5 to 1.5

years before leveling off (see Figure 5). This finding indicates that, on average and initially, positive alcohol expectancies become slightly more important in the alcohol-use decision making process. After this initial increase, the importance of these expectancies returns to a level just below that at baseline. At their peak at .5 years, Pros are significantly increased from baseline (t(1066) = 3.76, p < .01, d = .12). By 1.5 years, Pros are significantly reduced from .5 years (t(1066) = 6.33, p < .01, d = .19) and baseline (t(1066) = 2.82, p < .01, d = .08).

Figure 6

Predicted means and 95% CIs from unconditional growth in Cons model



As shown in Figure 6, the observed change in Cons over time supports the second hypothesis (H2: Negative alcohol expectancies will decrease over time with the greatest reduction occurring initially). Unlike pros there is no apparent shift in direction for growth in cons which decrease from baseline to 2 years. There are, however, differences in the rate of change. Cons exhibit steeper reductions from baseline to .25 years (m = -4.20) and again from 1 to 1.5 years (m = -1.76). As hypothesized, the greatest reduction in Cons occurs during the first 3 months of the study. Further, Cons at .25, .5 and 1 year are significantly lower than at baseline. The effect sizes for these statistically significant differences are .22, .26, and .26 respectively. Similarly, cons at 1.5 (d = .17) and 2 years (d = .16) are significantly lower than at 1 year. Together, these findings suggests that, over time, negative alcohol expectancies become less important in student decisions to use alcohol.

III. Conditional Growth in Positive and Negative Alcohol Expectancies

Models 1h (cubic growth in pros) and 2i (quartic growth in cons) served as base models for tests of conditional growth in positive and negative alcohol expectancies. Using the hierarchical model building procedure described in the last chapter, a series of increasingly complex nested models were tested to determine if change in Pros and Cons varied by levels of the selected predictors (i.e., predictor X time interactions). Following this evaluation, tests of conditional growth were completed to determine if the selected predictors moderated the effects of treatment on change in alcohol expectancies (i.e., treatment X predictor X time interactions). Each series started with the highest order interaction effect and proceeded by eliminating interaction and main effect terms that did not make significant contributions to the prediction model. Interaction and main effects were evaluated with type III tests of fixed-effects. The fixed-effect results of the best fitting multiple variable model are described.

III.A. Treatment X Time Interaction Effects

Tests of conditional growth involving two-way interaction effects between treatment and time indicated that change in Pros was moderated by treatment condition. Type III tests of fixed effects resulted in a statistically significant treatment X cubic time interaction effect for Pros ($F(1,4019) = 2.89$, $p < .10$, d = .15). There was no significant treatment X quartic time interaction effect for Cons, however, once removed from the model, a statistically significant treatment X cubic time interaction effect ($F(1,4015) = 10.99$, $p < .01$, d = .29) was found. The larger effect size for the treatment X cubic time interaction effect for Cons relative to Pros (.29 vs .15) as well as the lower probability of achieving these results by chance suggests that the moderation effects of treatment condition were stronger for Cons than for Pros. This finding does not support the first moderation hypothesis for treatment condition (H3: The moderation effects of treatment condition will be stronger for change in pros).

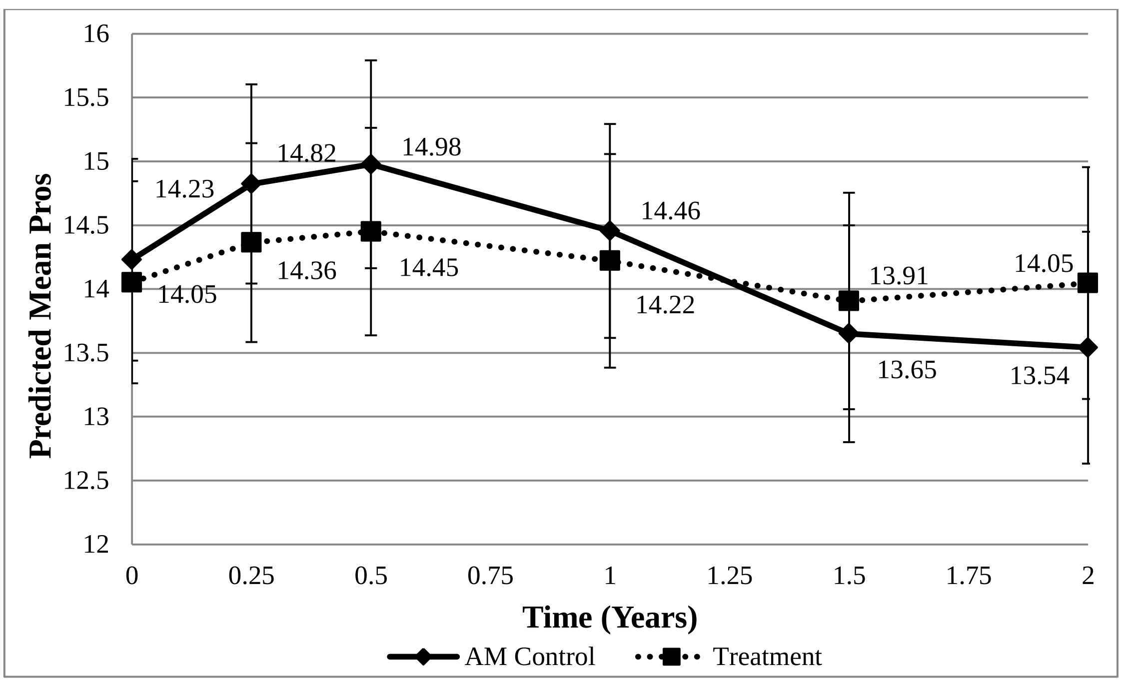
III.B.1. Predictor X Time Interaction Effects for Pros

The significant treatment X cubic time interaction effect for Pros was controlled for in subsequent tests of growth conditional on the remaining predictors. These tests indicated that change in Pros over time was conditional on gender, race, alcohol problems, cigarette smoking status and marijuana smoking status. Type III tests of fixed effects resulted in statistically significant gender X cubic time ($F(1,4016) = 2.88$, $p < .10$) , race X linear time ($F(1,4010) = 3.02$, $p < .10$), alcohol problems X quadratic time ($F(3,4011) = 2.45$, $p < .10$), cigarette smoking status X quadratic time ($F(2,4010) = 3.26$, $p < .05$) and marijuana smoking status X linear time (F(2,4008) =

5.08, $p < .01$) interaction effects. Type III tests of fixed effects also resulted in significant main effects for class year ($F(1,1064) = 10.73$, $p < .01$), peer influence ($F(2, 1054) = 68.72$, $p < .001$), and binge frequency ($F(3,1062) = 74.97$, $p < .001$). When the above fixed interaction and main effects were incorporated into a single, full model, cigarette smoking status no longer moderated change in Pros nor did it exhibit a significant main effect. Further, marijuana smoking status at baseline was limited to a main effect ($F(2,1037) = 3.11$, $p < .05$). Fixed effect estimates for the highest order fixed interaction and main effects from the full two-way conditional model are displayed in Table 15 (see Model 2) alongside the fixed effect estimates for the unconditional Pros model (Model 1).

Figure 7

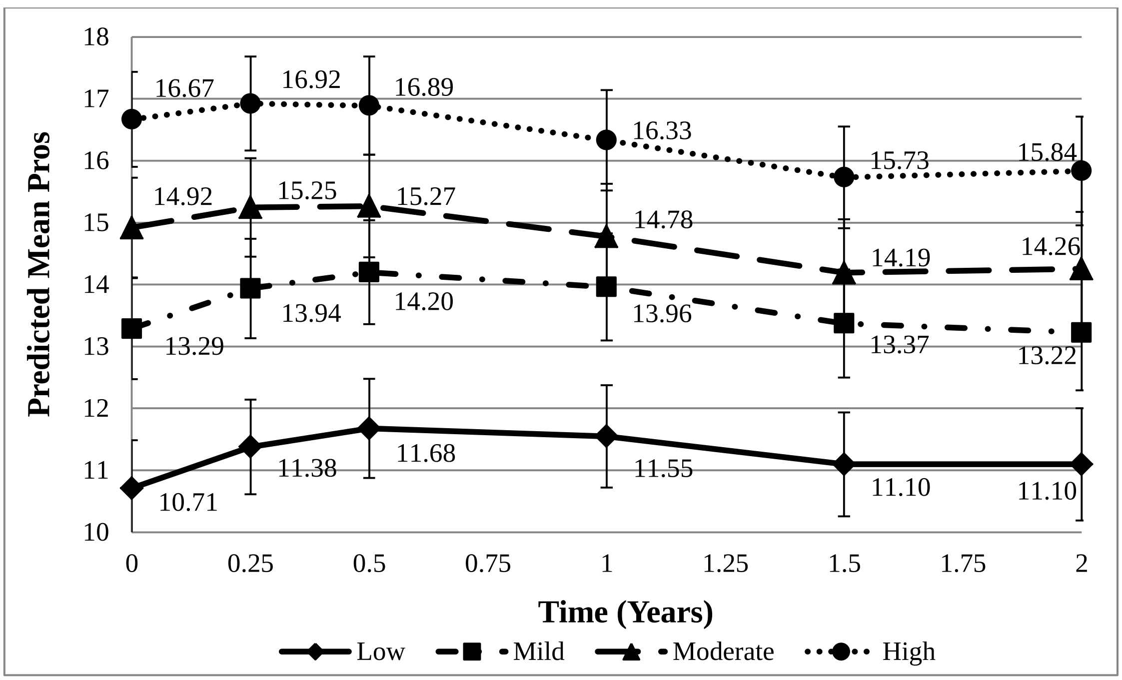
Predicted means and 95% CIs for growth in Pros conditional on treatment



The effects of treatment on change in Pros are depicted in Figure 7. In partial support of Hypothesis 4 (Students randomized to the treatment condition will experience and maintain more adaptive change in Pros and Cons relative to those assigned to the assessment matched condition) students assigned to the control condtion (AM Control) exhibited a greater increase in Pros from baseline to .5 years (14.98 – 14.23 = .75) relative to students assigned to the treatment condition (14.45 – 14.05 = .40). There was an unexpected finding in that students assigned to the control condition also exhibited a greater reduction in Pros from .5 to 2 years (-1.34 vs. -.42). By the end of the 2-year trial, students that did not receive treatment weighed the importance of pros of alcohol consumption less heavily when making decisions about how much to drink relative to students that received the intervention.

Figure 8

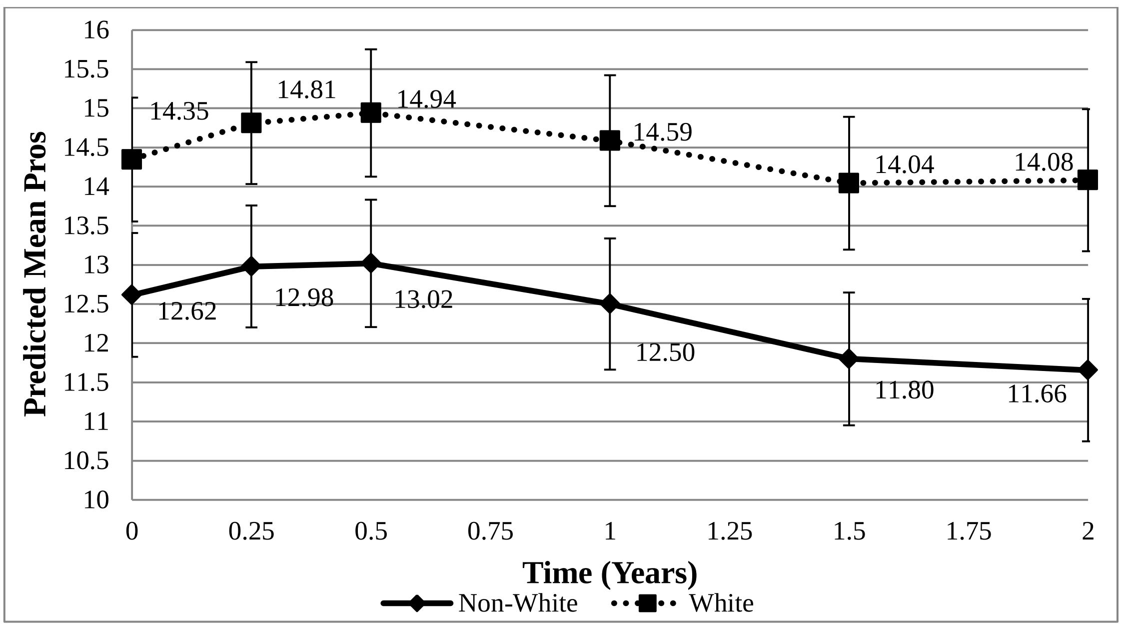
Predicted means and 95% CIs for growth in Pros conditional on alcohol problems



The effects of baseline alcohol problems on change in Pros are depicted in Figure 8. All subgroups exhibit a slight increase in Pros between baseline an .5 years prior to reducing from .5 to 1.5 years post-baseline. As hypothesized, students experiencing low problems (CAPS-r scores = 0) at the start of the trial maintain stastistically, significantly lower levels of Pros over time. At the other extreme, those experiencing high problems (CAPS-r scores $\geq$ 6) maintain statistically, significantly higher levels. The level difference in means Pros scores between students with Mild (CAPS-r score = 1 or 2) and Moderate (CAPS-r score = 3 to 5) problems narrows from baseline (14.92 – 13.29 = 1.63) to 1 year post-baseline (14.78 – 13.92 = .82). The level difference at baseline is two times the size of the level difference at 1 year.

Figure 9

Predicted means and 95% CIs for growth in Pros conditional on class year



The effects of race on change in Pros are depicted in Figure 8. Both Whites and Non-Whites exhibit a slight increase in Pros between baseline an .5 years prior to reducing from .5 to 1.5 years post-baseline. As hypothesized, Non-Whites maintain stastistically, significantly lower levels of Pros over time compared to Whites. In addition, mean Pros scores for Non-Whites exhibit a steeper reduction from .5 to 2 years post-baseline (11.66 – 13.02 = -1.36, vs. -.86 for Whites).

Table 15

Fixed Effects Estimates for Models of Predictors of Unconditional and Condtional Growth in Pros

		Model 1	Model 2	Model 3
Parameter	Level	Unconditional	Full Two-way	Full Two-way w/Tx*Pred*Time Interactions
Intercept	NA	14.13***(0.86)	8.68***(0.42)	9.78***(0.56)
Time (Linear)	NA	2.47***(0.44)	4.76***(0.86)	3.51***(1.02)
$Time^2$ (Quadratic)	NA	-3.29***(0.54)	-5.64***(0.93)	-5.06***(0.97)
$Time^3$ (Cubic)	NA	0.99***(0.18)	1.58***(0.30)	1.57***(0.30)
Class year	Freshmen	.	0.77***(0.20)	0.66** (0.31)
	Sophomore	.	0	0
Peer influence	High	.	1.20***(0.32)	1.13***(0.32)
	Medium	.	0.85***(0.25)	0.79***(0.25)
	Low	.	0	0
Binge freq.	High	.	1.73***(0.35)	1.82***(0.48)
	Mild	.	1.06***(0.29)	1.39***(0.44)
	Moderate	.	1.80***(0.35)	2.22***(0.51)
	Low	.	0	0
Marijuana use	Frequent	.	-0.69** (0.28)	-0.68** (0.28)
	Infrequent	.	-0.23 (0.26)	-0.26 (0.26)
	Nonsmoker	.	0	0
$Treatment*time^3$	Treatment	.	-0.59* (0.36)	-0.59* (0.36)
	AM Control	.	0	0
$Gender*time^3$	Male	.	-0.61* (0.36)	-0.62* (0.36)
	Female	.	0	0
Race*time	White	.	0.41* (0.21)	0.40* (0.22)
	Non-white	.	0	0
Alc. $problems*time^2$	High	.	0.57* (0.28)	0.62** (0.31)
	Mild	.	-0.03 (0.30)	-0.05 (0.31)
	Moderate	.	0.46 (0.29)	0.51* (0.29)
	Low	.	.	0
Treatment*gender*time	Male	.	.	-0.58** (0.27)
	Female	.	.	0
Treatment*class year*time	Freshmen	.	.	-0.48* (0.27)
	Sophomore	.	.	0
Treatment*binge $freq.*time^2$	High	.	.	0.73 (0.53)
	Mild	.	.	-0.81 (0.52)
	Moderate	.	.	0.36 (0.63)
	Low	.	.	0

Notes. This table summarizes the fixed effect estimates for the unconditional, full two-way and full two-way with significant treatment X predictor X time interaction effects (i.e., final model) models for positive alcohol expectancies. Model 1 served as the base model for two-way tests conditional growth in Pros. Model 2 served as the base model for three-way tests of conditional growth examining the effects of treatment conditional on significant Model 2 predictors. Type III tests of fixed effects resulted in a significant treatment X binge frequency interaction effect that is not apparent through fixed-effect estimates. Standard errors are in parentheses. Tx = treatment; Pred = predictor; NA = not applicable; Binge freq. = binge frequency; Alc. problems = alcohol problems.
**p* < .10, ***p* < .05, ****p* < .01.

The relationships between change in Pros over time and gender, class year, and baseline binge frequency will be discussed in the next section in light of three-way interaction effects with treatment and time. As shown in Table 15, mean Pros scores for baseline marijuana use and peer influence subgroups differed at baseline (see Model 2). Fixed effects estimates indicate that students that reported frequent marijuana use at baseline ($\beta = -.69$, $p < .05$) weigh the pros of alcohol use less heavily when making decisions about how much to drink than do nonsmokers. Similarly, students that self-reported Medium ($11 \leq s \leq 14$) and High ($s \geq 15$) levels of peer influence had statistically, significantly higher mean Pros scores at baseline compared to students subject to Low ($s \leq 10$) levels of peer influence ($\beta_{Medium} = .85$, $p < .01$; $\beta_{High} = 1.20$, $p < .01$).

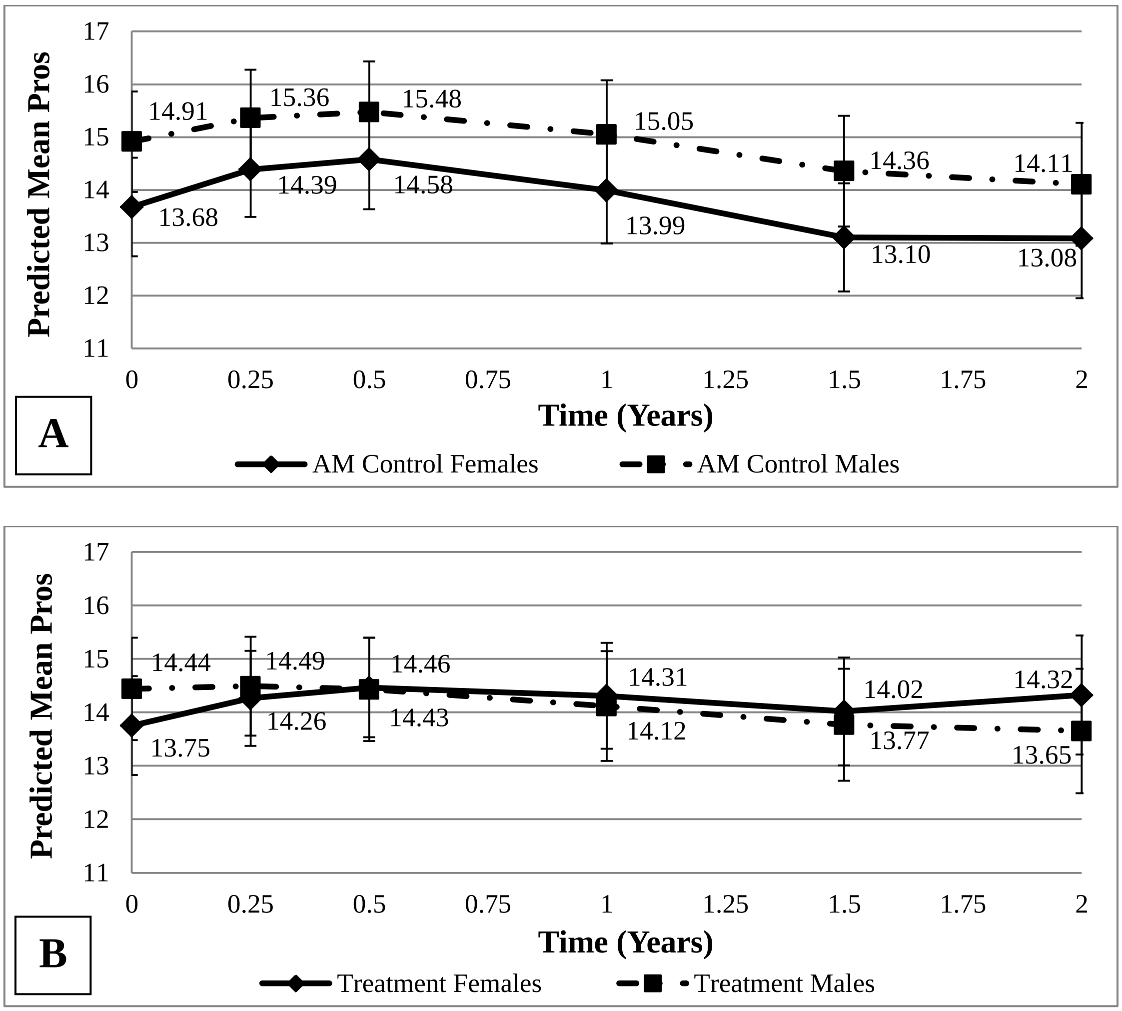
III.B.2. Treatment X Predictor X Time Interaction Effects for Pros

The full two-way interaction model (see Model 2 in Figure 15) served as the base model for LMER tests to determine if the effects of treatment on change in Pros were conditional on the significant main effect and interaction terms already identified. Three-way interaction terms between treatment and time and the predictors of gender, race, class year, peer influence, binge frequency, alcohol problems and marijuana use were tested. Type III tests of fixed effects resulted in statistically significant treatment X gender X linear time ($F(1,3946) = 4.60$, $p < .05$) , treatment X class year X linear time ($F(1,3946) = 3.23$, $p < .10$), and treatment X binge frequency X quadratic time ($F(3,3946) = 2.90$, $p < .05$) interaction effects. The fixed effect estimate for the higher order interaction terms are displayed in Table 15 (see Model 3).

All lower order terms are included in the model, however, due to space limitations have not been supplied in Table 15.

Figure 10

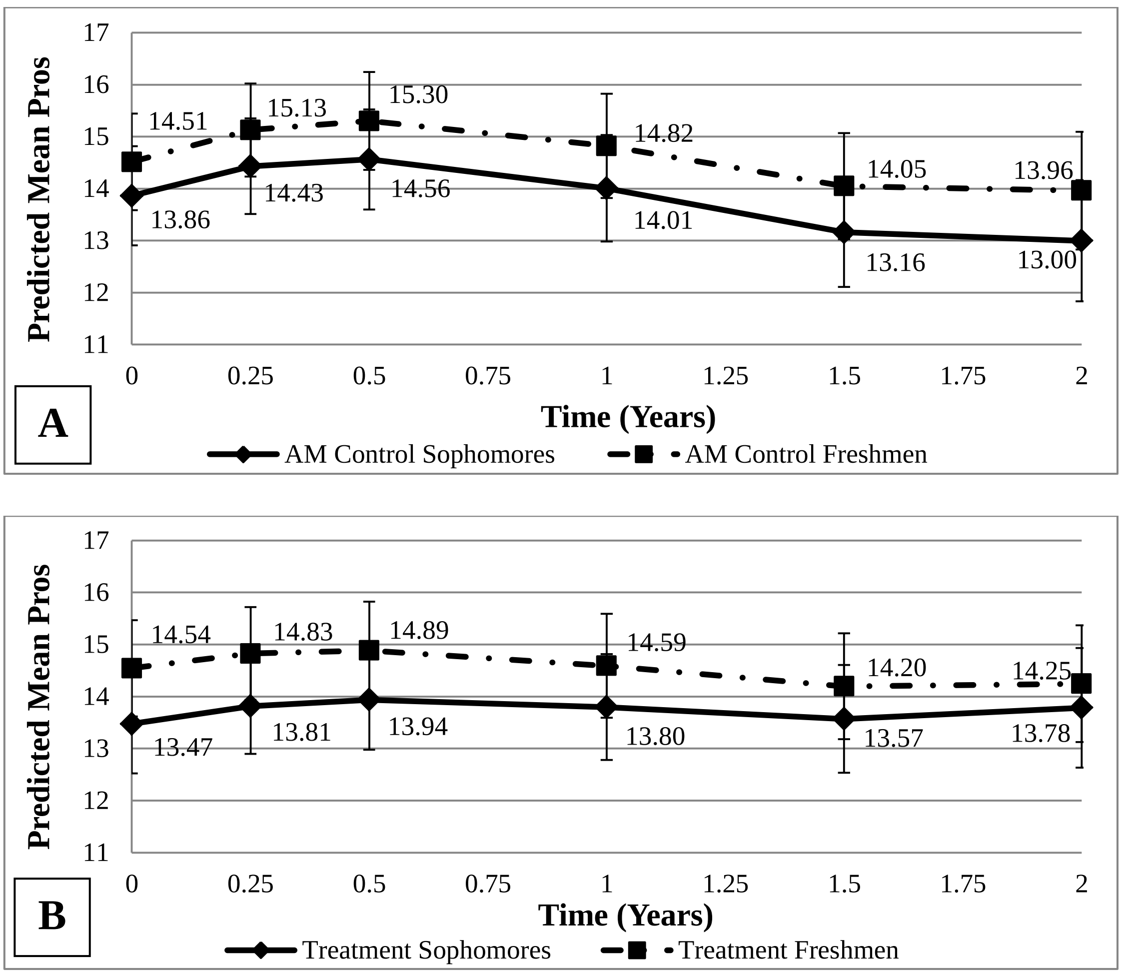
Predicted means and 95% CIs for growth in Pros conditional on treatment and gender



The effects of gender on change in Pros vary by levels of treatment condition. These relationships are depicted in Figures 10A and B. In Figure 10A, predicted mean Pros scores for males and females assigned to the AM Control condition are plotted. Within this condition, male and females are separated by level differences in Pros over time. Females maintain the lowest levels of Pros over time relative to males. Both groups exhibit an increase in Pros from baseline to .5 years prior to a gradual reduction from .5 to 1.5 years post-baseline. These trends are not consistent with those of males and females assigned to the Treatment condition (see Figure 10B). Males begin the trial with a higher level of Pros, however, end the trial with a lower level. The 95% CIs indicate that the level differences across time points in Pros for males assigned to the treatment condition are not statistically, significantly different from those of females.

Figure 11

Predicted means and 95% CIs for growth in Pros conditional on treatment and class

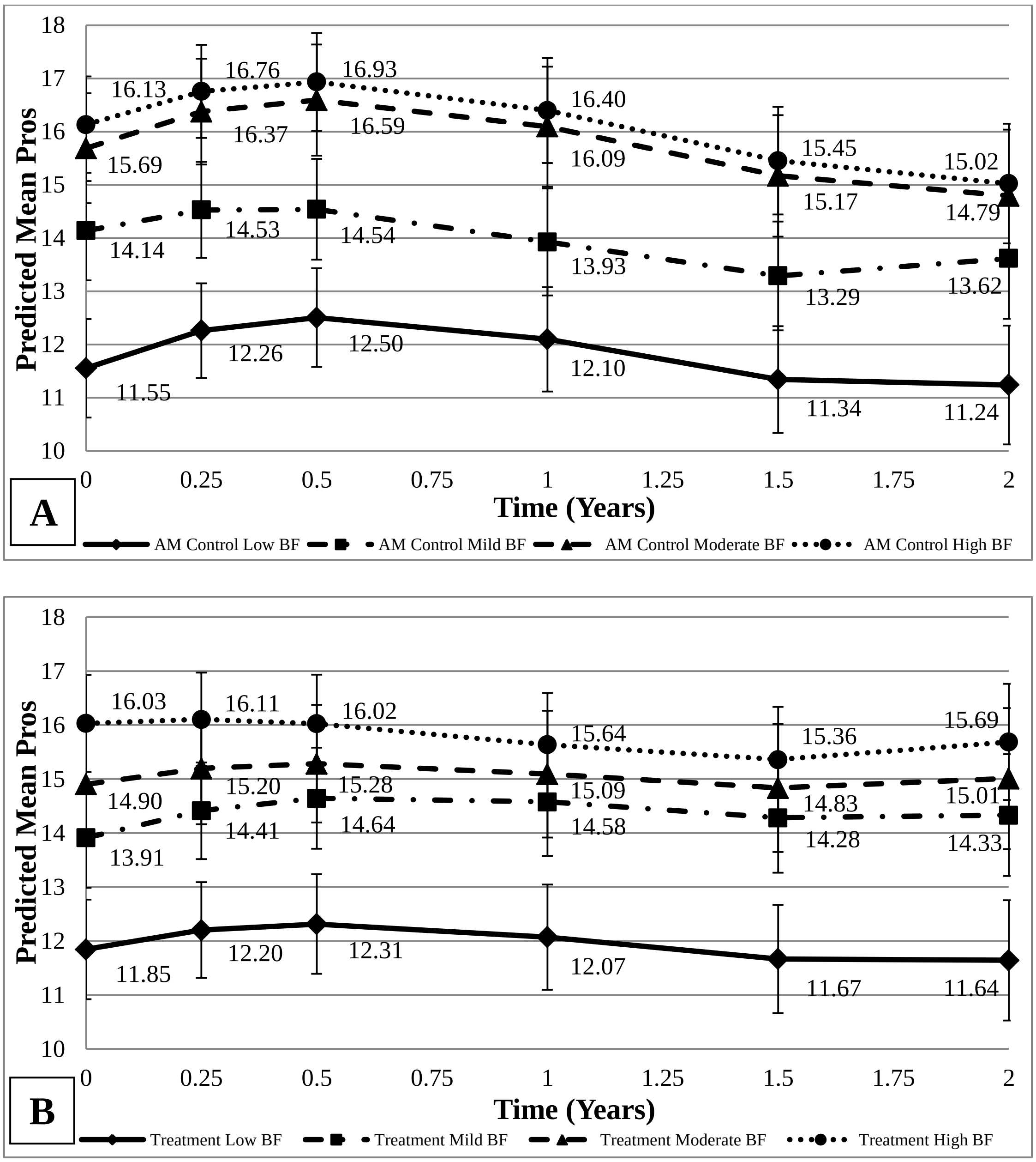


The effects of the predictors of class year and baseline binge frequency on change in Pros also vary by levels of treatment condition. These relationships are depicted in Figures 11A and B (for class year subgroups) and Figures 12A and B (for binge frequency subgroups). Consistent with previous plots involving treatment, plotted predicted mean Pros scores for students assigned to the AM Control condition show that Pros increase to a greater extent for these students regardless of subgroup. The peak Pros score at .5 years for AM Control freshmen and sophomores are 15.30 and 14.56 respectively. By comparison, the peak Pros scores at .5 years for Treatment freshmen and sophomores are 14.89 and 13.94. Similar peak Pros score differences between subgroups within treatment conditions are seen for binge frequency classifications. This is additional proof that the CBARR intervention benefitted college student cognitions of the positive effects of alcohol during the intervention period.

Consistent with previous findings, Pros for freshmen and sophomores as well as Low (0 binge episodes in the past 30 days), Mild (1-2 binge episodes), Moderate (3-4 binge episodes) and High (5 or more binge episodes) binge frequency drinkers assigned to the Treatment condition are higher at the end of than for their counterparts assigned to the AM Control condition. In the case of class year, there is considerable overlap in 95% CIs between groups within treatment conditions. This is not the case for binge frequency subgroups. As hypothesized, students that self-reported lower binge frequency at baseline maintained the lowest levels of Pros relative to their peers. In both the AM Control and Treatment conditions students in the Low binge frequency group has statistically, significantly lower predicted mean Pros scores across time points compared to all other subgroups. Further, in the AM Control condition, there is little difference in growth in Pros between Moderate and High binge frequency subgroups.

Figure 12

Predicted means and 95% CIs for growth in Pros conditional on treatment and binge frequency



III.C. Predictor X Time Interaction Effects for Cons

The significant treatment X cubic time interaction effect for Cons discussed in section *III.A. Treatment X Time Interaction Effects* was controlled for in subsequent tests of growth conditional on the remaining predictors. These tests indicated that change in Cons over time was conditional on gender, binge frequency, parent alcoholism, alcohol problems, cigarette smoking status and marijuana smoking status. Type III tests of fixed effects resulted in statistically significant gender X quadratic time ($F(1,4013) = 4.58$, $p < .05$) , binge frequency X cubic time ($F(3,4006) = 2.25$, $p < .10$), parent alcoholism X quartic time ($F(2,4011) = 14.29$, $p < .001$), alcohol problems X cubic time ($F(3,4004) = 3.13$, $p < .05$), cigarette smoking status X quartic time ($F(2,4002) = 2.85$, $p < .10$) and marijuana smoking status X cubic time ($F(2,3999) = 3.87$, $p < .05$) interaction effects. Type III tests of fixed effects also resulted in significant main effects for race ($F(1,1062) = 6.26$, $p < .05$) and peer influence ($F(2, 1054) = 5.05$, $p < .01$).

When the above fixed interaction and main effects were incorporated into a single, full model, parent alcoholism no longer moderated change in Cons nor did it exhibit a significant main effect. The fixed main effects for race and peer influence were no longer significant. Binge frequency and alcohol problems at baseline were limited to a main effects ($F(3,1038) = 8.69$ $p < .001$ and $F(3,1038) = 7.81$, $p < .001$ respectively). Fixed effect estimates for the highest order significant interaction and main effects from the full two-way conditional model are displayed in Table 16 (see Model 2) alongside the fixed effect estimates for the unconditional Cons model (Model 1). Model 2 served as the base model for LMER analyses that examined the effects of treatment on change in Cons conditional on significant Model 2 predictors. There were no significant three-way interaction effects. Unlike Pros, the effects of treatment were not moderated by demographic, social, family history, alcohol use or other substance use predictors. The final model for conditional growth in Cons is the full two-way model. Once again, plots of predicted means have been supplied to aid in the description of interaction effects.

Table 16

Fixed Effects Estimates for Models of Predictors of Unconditional and Condtional Growth in Cons

		Model 1	Model 2	Model 3
Parameter	Level	Unconditional	Full Two-way	Full Two-way w/Tx*Pred*Time Interactions
Intercept	NA	17.78***(0.15)	18.12***(0.37)	.
Time (Linear)	NA	-6.95***(0.89)	-5.70***(1.46)	.
$Time^2$ (Quadratic)	NA	13.35***(2.18)	8.94***(3.18)	.
$Time^3$ (Cubic)	NA	-10.19***(1.81)	-6.46** (2.55)	.
$Time^4$ (Quartic)	NA	2.49***(0.47)	1.55** (0.65)	
Binge freq.	High	.	-1.84***(0.37)	.
	Mild	.	-0.83** (0.29)	.
	Moderate	.	-1.37*** (0.39)	.
	Low	.	0	.
Alc. problems	High	.	1.78***(0.38)	.
	Mild	.	1.31***(0.37)	.
	Moderate	.	1.03***(0.37)	.
	Low		0	
Treatment*$time^3$	Treatment	.	-1.45***(0.43)	.
	AM Control	.	0	.
Gender*$time^2$	Male	.	-0.46* (0.24)	.
	Female	.	0	.
Cigarette use*$time^4$	Frequent	.	2.93** (1.20)	.
	Infrequent	.	1.31 (1.13)	.
	Nonsmoker	.	0	.
Marijuana use*$time^3$	Frequent	.	0.94* (0.56)	.
	Infrequent	.	1.38** (0.55)	.
	Nonsmoker	.	0	.

Notes. This table summarizes the fixed effect estimates for the unconditional and full two-way (i.e., final model) models for negative alcohol expectancies. Model 1 served as the base model for two-way tests of conditional growth in Cons. Model 2 served as the base model for three-way tests of conditional growth examining the effects of treatment conditional on significant Model 2 predictors. There were no significant three-way treatment X predictor X time interaction effects. Standard errors are in parentheses. Tx = treatment; Pred = predictor; NA = not applicable; Binge freq. = binge frequency; Alc. problems = alcohol problems.
**p* < .10, ***p* < .05, ****p* < .01.

The effects of treatment on change in Cons are depicted in Figure 13. In partial support of Hypothesis 4 (Students randomized to the treatment condition will experience and maintain more adaptive change in Pros and Cons relative to those assigned to the assessment matched condition) students assigned to the control condition (AM Control) exhibited less reduction in Cons from baseline to .5 years (16.95 – 17.75 = -.80) relative to students assigned to the treatment condition (16.03 – 17.73 = -1.7). There is some evidence for a rebound effect for treatment. From .5 to 1 year post-baseline Cons increase within the treatment group while the importance of Cons continue to reduce for AM Control students. By the end of the 2-year trial, students that did not receive treatment weighed the importance of cons of alcohol consumption less heavily when making decisions about how much to drink relative to students that received the intervention.

Figure 13

Predicted means and 95% CIs for growth in Cons conditional on treatment

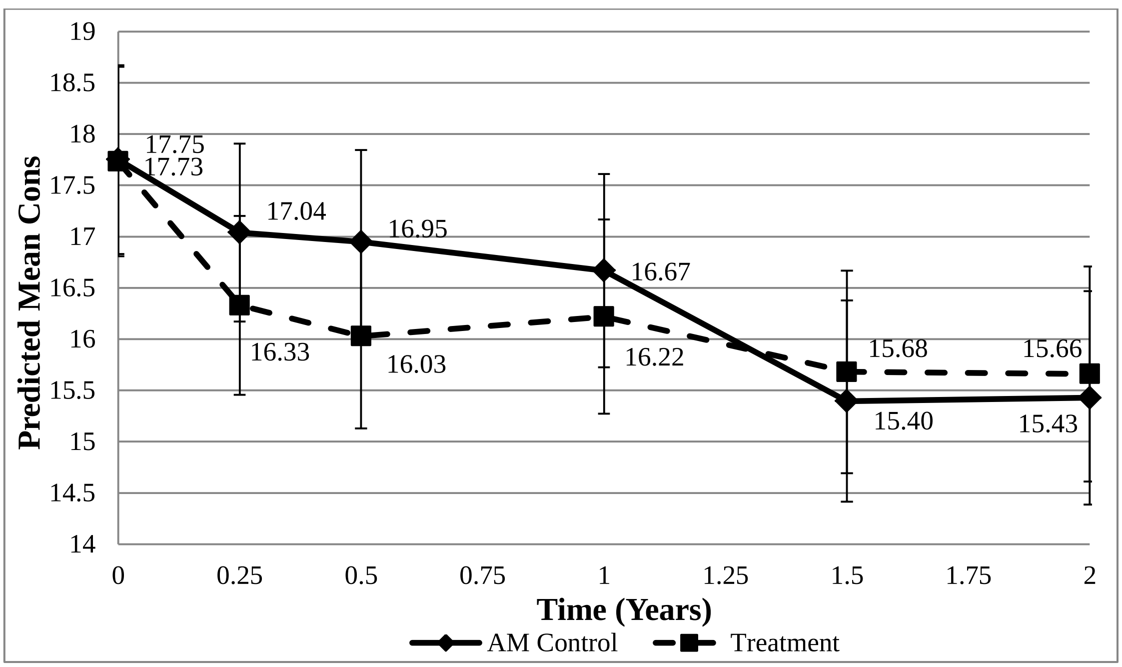
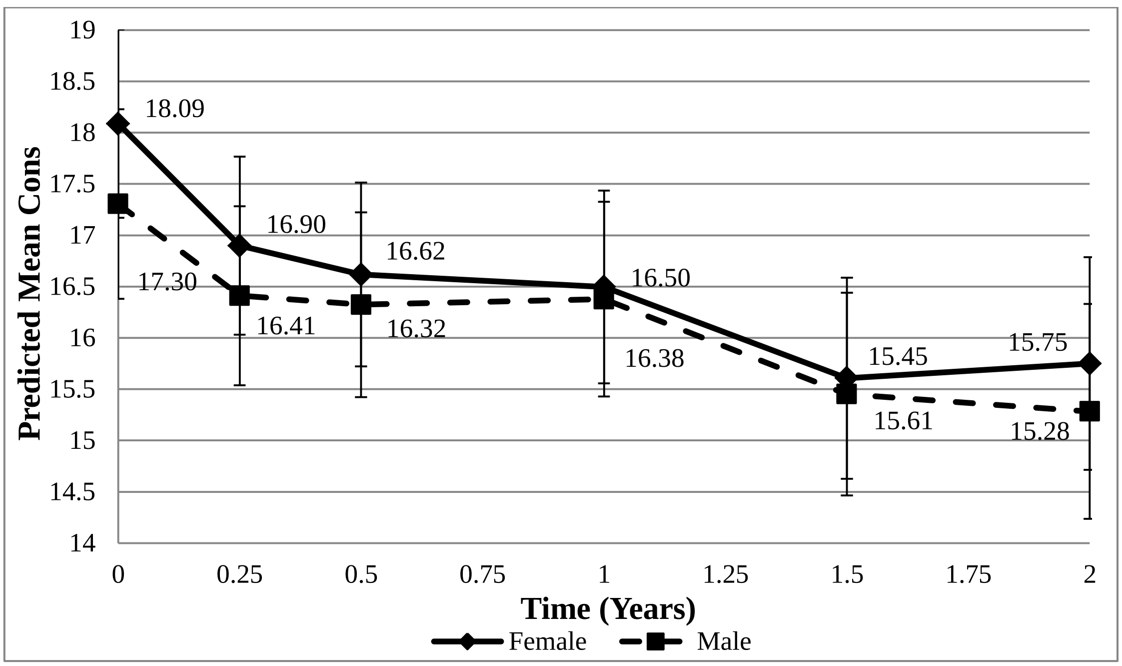


Figure 14 depicts the relationship between gender and change in Cons over time. The pattern of change in Cons exhibited by males and females is similar to the plot of predicted means for unconditional growth in Cons (see Figure 6). Cons decrease the most from baseline to .25 years and again from 1 to 1.5 years for both groups with the greatest reduction occurring over the first 3 months of the study. Females maintain the highest levels of Cons over time, however, the level difference at 1 year post-baseline between groups is negligible (16.50 – 16.38 = .12).

Figure 14

Predicted means and 95% CIs for growth in Cons conditional on gender

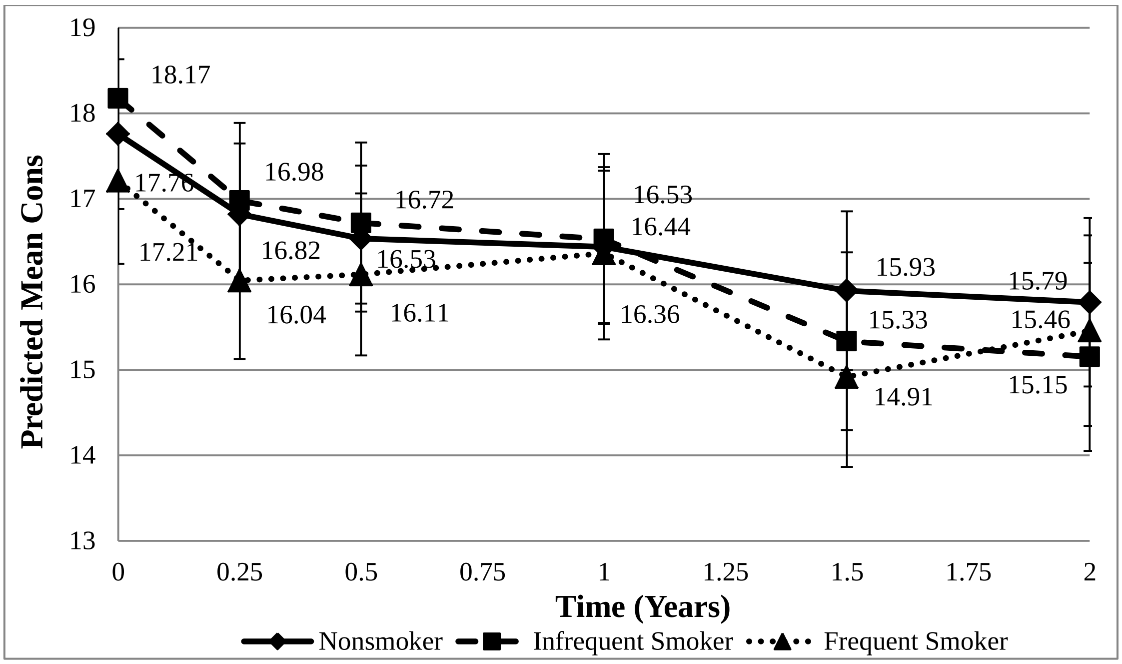


Cigarette and marijuana use at baseline were the final two predictors that moderated change in Cons. The relationship between cigarette smoking status and change in Cons is depicted in Figure 15. Infrequent smokers started the trial with the highest predicted mean Cons score (18.17), followed by nonsmokers (17.76) and frequent smokers (17.21). These level differences exist until 1 year post-baseline.

From baseline to 1 year Cons for infrequent and nonsmokers reduce. Cons continue to fall for infrequent smokers. By 2 years post-baseline, infrequent smokers replace frequent smokers as the group with the lowest level of Cons. Nonsmokers end the trial with the highest level.

Figure 15

Predicted means and 95% CIs for growth in Cons conditional and cigarette use

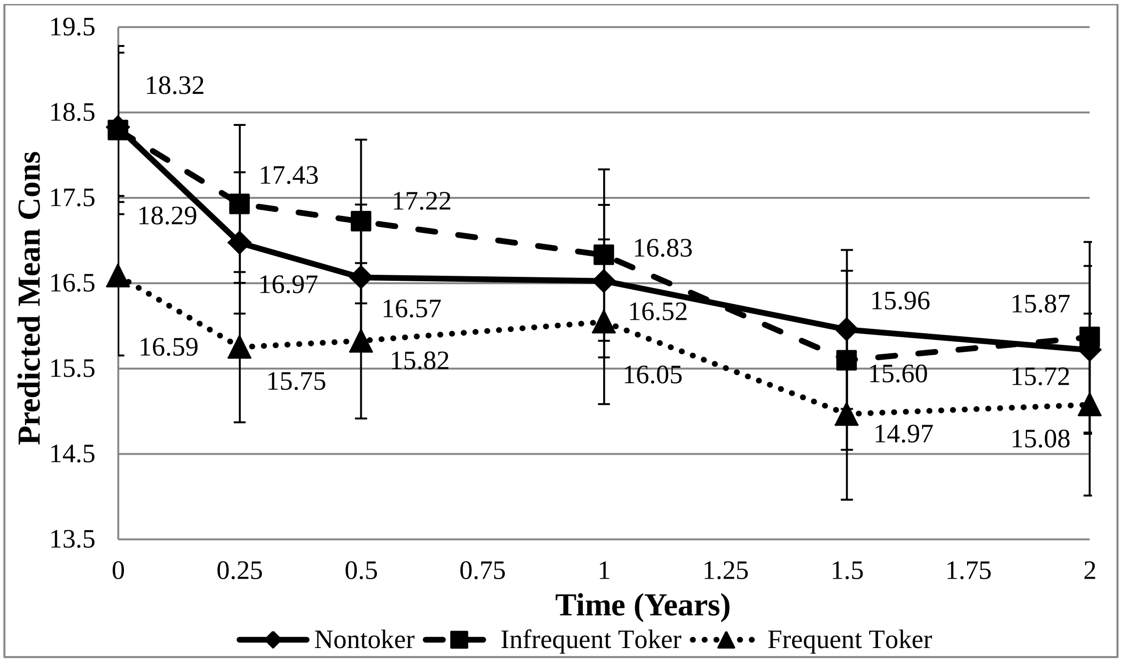


As shown in Figure 16, the pattern of change in Cons for frequent marijuana smokers is similar to that of frequent cigarette smokers from baseline to 1.5 years. Frequent marijuana smokers maintain the lowest levels of Cons throughout the CBARR trial. Infrequent marijuana smokers (Infrequent Tokers) were observed to weigh the cons of alcohol use more heavily when making decisions about how much to drink during the interavetion period. From 1 to 2 years post-baseline change in Cons in addition to predicted mean Cons scores is similar for Infrequent and

Nontokers. Both groups start (18.32 vs. 18.29) and end (15.87 vs. 15.72) the trial at similar levels.

Figure 16

Predicted means and 95% CIs for growth in Cons conditional and marijuana use



The full two-way model, in addition to the interaction effects just described, resulted to two significant main effects. As shown in Table 16, mean Cons scores for baseline binge frequency and alcohol problems subgroups differed at baseline (see Model 2). Fixed effects estimates indicated that students that reported Mild ($\beta = -.83$, $p < .05$), Moderate ($\beta = -1.37$, $p < .01$) and High ($\beta = -1.84$, $p < .01$) binge frequency at baseline weigh the pros of alcohol use less heavily when making decisions about how much to drink than do students that did not engage in binge drinking in the month prior to the study. This pattern is not shared by alcohol problems subgroups. Fixed effects estimates indicated that students that reported Mild ($\beta = 1.31$, $p < .01$), Moderate ($\beta = 1.03$, $p < .01$) and High ($\beta = 1.78$, $p < .01$) alcohol problems at baseline weigh the cons of alcohol use more heavily when making decisions about how much to drink than do students experiencing no problems as a result of their alcohol use.

IV. Summary

This chapter details the results of all analyses performed, starting with findings of unconditional LMER tests to identify the functional form of change in alcohol expectancies. This step, of properly modeling group-level change while accounting for individual variation, was an essential precursor to examining moderation hypotheses. Results indicated that change in positive and negative alcohol expectancies was best modeled with curvilinear, continuous growth functions. In both cases, continuous curvilinear time specifications outperformed linear piecewise models. At the group level, pros were observed to increase initially then rebound whereas cons reduced over the course of the trial at varying rates.

Findings of conditional LMER tests examining moderators of change in alcohol expectancies were presented next starting with treatment. Treatment proved to be a significant moderator of change in Pros and Cons as were the predictors of gender, baseline binge frequency, alcohol problems, and marijuana smoking use. Class year moderated change in Pros and Pros varied at baseline for peer influence subgroups. Baseline marijuana smoking status moderated change in Cons. The relationship between these moderators and change fully supported the moderation hypothesis (H5) for positive alcohol expectancies. Greek status and parent alcoholism did not prove to be significant predictors of alcohol expectancies.

The final analyses tested whether the selected predictors moderated the effects of treatment on change in alcohol expectancies. No significant three-way interaction effects for Cons were found. Gender, class year and baseline binge frequency moderated the effects of treatment on change in Pros. Across all subgroups, those assigned to the treatment condition experienced less positive growth in positive alcohol expectancies relative to students assigned to the assessment-only control condition in the final year of the study.

In the following chapter (Chapter 4), these results are discussed in light of the literature. Explanations for unexpected findings are presented in addition to the implications of these findings for BMI interventions designed to reduce high risk drinking by college students. The chapter is concluded with a discussion on limitations of the present study and future directions.

CHAPTER 4

CONCLUSION

I. Change in Alcohol Expectancies Over Time

There were two primary objectives in this study. The first objective was to determine how positive and negative alcohol expectancies develop over a two year period early in the college experience. This question was addressed through tests of unconditional growth that involved hierarchical modeling. Linear mixed effects regression analyses of unconditional growth indicated that change in positive and negative alcohol expectancies was best modeled with continuous, curvilinear time. In both cases (modeling of Pros and Cons), continuous models predicting non-linear change outperformed piecewise models. The latter were considered a simpler alternative to modeling change in expectancies due to treatment and its delayed effects. The fact that higher-order curvilinear growth functions provided a better fit to the data suggests that group-level change in alcohol expectancies over the course of the CBARR trial was dynamic, consisting of multiple rate changes and, in the case of positive alcohol expectancies, a direction change that were not properly modeled by linear time specifications. The plots of predicted means for all unconditional and conditional models as well as the plot of least squares means from the nominal time model support this conclusion.

As hypothesized, at the group level, positive alcohol expectancies increased at the beginning of the trial, from baseline to 3 months (.25 years), then decreased over the remainder. This effect was more evident for assessment-matched students. This is an important detail as it is the control group who exemplify natural change in alcohol expectancies over time. Results partially supported the hypothesized relationship for change in negative alcohol expectancies. Cons reduced gradually, however, the greatest rate of change did not occur at the start of the trial for assessment-matched students. Instead, the greatest reduction in negative alcohol expectancies occurred from 1 to 1.5 years for students in the control group. This finding was unexpected.

The group level change in positive alcohol expectancies observed for students that participated in the CBARR trial fits well within the alcohol expectancy literature. The increase in positive expectancies from baseline to 3 months coincides with a period of time in which drinking is increased for most students (Capone, Wood, Borsari & Laird, 2007; Lee, Maggs & Rankin, 2006; Grekin & Sher, 2006; Hartzler & Fromme, 2003; Weitzman, Nelson & Wechsler, 2003; Adams & Nagoshi, 1999). While change in alcohol consumption was not examined in this study, findings from previous longitudinal investigations on change in alcohol expectanices, alcohol use and problems among college students indicate that the two are positively related (Sher, Wood, Wood & Raskin, 1996; Cronce, Fairlie, Atkins & Lee, In Press). This would also explain the gradual reduction in positive alcohol expectancies from 3 months to 2 years, which is thought to occur alongside, if not influence, reductions in alcohol use (Park, 2004; Park & Grant, 2005).

The theory of rational decision making as it relates to adaptive behavior change provides further support for the initial increase then gradual reduction in positive alcohol expectancies that occurs after 3 months. According to the

Transtheoretical Model (TTM; Prochaska, DiClemente & Norcross, 1992), as a student takes steps towards reducing alcohol use, he/she will weigh the pros of that use less heavily compared to the cons. Conversely, as a student increases alcohol use, he/she will weigh the cons of that use less heavily compared to the pros.

This shift in decisional balance, which has been observed in studies of numerous problem behaviors (Prochaska et al., 1994), provided a partial basis for the hypothesized change in Cons. It was expected that the greatest decrease in Cons would coincide with the period in time in which college student drinking was at its highest. The trajectory for unconditional growth supports this hypothesis, however, the observed growth conditional on treatment effects does not. Findings underscore the complicated relationship between cognitions of negative aspects of alcohol use and heavy drinking by college students (Leigh & Lee, 2008; Mallet, Bachrach & Turrisi, 2008). The fact that Cons reduced gradually over time suggests that beliefs about the negative aspects of alcohol use held by the average drinker become less important in students' alcohol-use decision making process over time which may be due to reductions in heavy alcohol use (Cronce, Fairlie, Atkins & Lee, In Press). This pattern of change may not apply to students that experience greater negative consequences as result of their alcohol use (Collins & Carey, 2005; Carey, Henson, Carey & Maisto, 2007; LaBrie, Pederson, Earleywine & Olsen, 2006). The significant main effect for alcohol problems supports this assertion. At baseline, students that experienced more alcohol-related problems weigh the Cons more heavily when making decisions about how much to drink, followed students that self-reported Moderate and Mild problems.

II.A. Treatment Effects on Change in Alcohol Expectancies

The second objective of this study was to determine if meaningful demographic, peer influence, family history, alcohol use-related and other substance use factors moderated change in alcohol expectancies over time. The data used in this study was collected as part of a randomized control trial for college drinkers that was designed to reduce alcohol problems through the administration of a brief motivational interview (BMI) and the provision of tailored feedback. As such, this study offered the opportunity to examine moderated change in alcohol expectancies within the context of a BMI. This is viewed as a strength in the present study. Given that students were randomized to treatment and control conditions, with treatment students receiving an intervention intended to influence the dependent measure for positive alcohol expectancies (Pros), this examination started with tests of treatment effects.

Linear mixed effects regression analyses of conditional growth indicated that treatment significantly influenced change in positive and negative alcohol expectancies. There were statistically significant treatment X cubic time interactions for Pros and Cons with some evidence that the treatment effect on Cons was stronger than that for Pros. This was not expected as the intervention did not specifically target Cons. It is possible that, in targeting pros, participants completed an exercise that reminds them of the many positive effects of alcohol use which unintentionally reinforces positive expectancies (Carey, Carey, Maisto & Henson, 2006; Collins & Carey, 2005). This may explain the seemingly narrow level differences between Treatment and AM Control conditions in Pros relative to Cons.

The tests of conditional growth examining treatment effects provided partial support for the second moderation hypothesis. Students that received the intervention exhibited more adaptive change in positive and negative alcohol expectancies during the intervention period only. Assessment-matched students exhibited a larger increase in Pros from baseline to 3 months and maintained a higher level of Cons from baseline to 1 year. This provides evidence that the BMI intervention and tailored feedback may have motivated students to abstain from heavy alcohol use that would facilitate reciprocal increases (or lack of reduction in Cons) in alcohol expectancies, use and problems (Cronce, Fairlie, Atkins & Lee, In press; Sher, Wood, Wood & Raskin, 1996; Christiansen, Smith, Roehling & Goldman, 1989). This would also explain the greater reduction in positive alcohol expectancies that occurs for AM Control students from 6 months to 2 years. That is, students that did not receive the intervention may have experienced increases in alcohol use leading to negative consequences that served as a necessary pre-requisite to changing unhealthy cognitions. This question can be addressed as a follow-up study through longitudinal mediation analyses.

There is little evidence to suggest that the BMI intervention employed in the CBARR trial produced lasting effects on alcohol expectancies. Level differences in alcohol expectancies began to dissipate as early as 6 months. Level differences Pros and Cons between Treatment and AM Control subgroups were negligigle at 1-, 1.5- and 2-year follow-ups. This decay is typical of alcohol expectancy interventions (Musher-Eizenman & Kulik, 2003; Wood, Capone, Laforge, Erickson & Brand, 207). Both Treatment and AM Control students concluded the trial with similar levels of positive and negative alcohol expectancies.

II.B. Predictor Effects on Change in Alcohol Expectancies

After examining treatment as a moderator of change in alcohol expectancies it was possible to move on to tests of conditional growth involving baseline classifications of gender, race, class year, Greek status, peer influence, parent alcoholism, binge frequency, alcohol problems, cigarette and marijuana use. Each of these predictors were hypothesized to moderate change in alcohol expectancies. After controlling for treatment effects, the only predictors that did not moderate change in Pros and Cons were Greek status and parent alcoholism.

The null finding for Greek status could be due to the fact that students who self-reported Greek affiliation or expressed the desire to join a fraternity or sorority were classified as Greek members. Post hoc analyses provided that nearly half (46%) of current members were sophomores who held healthier cognitions of positive (lower Pros) and negative (higher Cons) alcohol expectancies at baseline. Considering the research that has been conducted on the assocations between Greek membership, alcohol use and problems, it is reasonable to speculate that these analyses, completed in a sample with larger, Greek-affiliated and intending subsamples, woud lead to different findings (Cashin, Presley & Meilman, 1998; Engs, Diebold & Hanson, 1996; Wechsler, Dowdall, Davenport & Castillo, 1995). Two-way tests of fixed effects indicated that parent alcoholism moderated change in Cons, however, when added to the full model, which accounted for the effects of other predictors, the effects of parent alcoholism on change in Cons were no longer signficant. This finding indicates that parent alcoholism did not contribute to the overall prediction model above and beyond treatment, gender, binge frequency, alcohol problems and cigarette and marijuana use.

The remaining predictors moderated change in alcohol expectancies or had subgroups that varied on levels of Pros and Cons at baseline (i.e., exhibited significant main effects). The full two-way model for Pros included significant interactions between gender, race, alcohol problems and time in addition to main effects for class year, peer influence, binge frequency and marijuana use. The full two-way model for Cons included significant interactions between gender, cigarette use, marijuana use and time in addition to main effects for binge frequency and alcohol problems. The effects of gender, class year and binge frequency on change in Pros over time are discussed in the following section due to the fact that these variables moderated the effects of treatment on change in Pros.

Signficant main effects for peer influence and marijuana use were observed for positive alcohol expectancies. Students subject to lower levels of peer influence had statistically lower Pros at baseline. Unlike peer influence, the relationship between marijuana use and positive alcohol expectancies was unanticipated. It was expected, given the positive correlation between marijuana and binge drinking observed in previous studies (Bell, Wechsler & Johnston, 1997; Mohler-Kuo, Lee & Wechsler, 2003) and the positive correlation between Pros and binge frequency described in Chapter 3, that students that reported use of marijuana at baseline would weigh the positive aspects of alcohol use more heavily when making decisions about how much to drink. The opposite was found. Non-marijuana smokers (Nontokers) had stastically higher Pros at baseline relative to infrequent and frequent smokers.

The predictors of race and alcohol problems moderated change in positive alcohol expectancies over time. In both cases the moderation hypothesis was met.

Non-Whites maintained a lower level of positive alcohol expectancies relative to Whites, who commonly self-report greater alcohol use and problems (O'Malley & Johnston, 2002; Weitzman, Nelson, & Wechsler, 2003; Wechsler & Nelson, 2008). Students experiencing problems as a result of their alcohol use maintained statistically higher Pros over time yet exhibited a greater reduction in Pros from 6 months to 1.5 years (~ 1 point reduction) compared to students that reported an absence of alcohol-related problems (CAPS-r score = 0). This finding supports the idea that the experience of greater problems due to alcohol use makes one less ambivalent about the pros of behavior change (Collins & Carey, 2005; Migneault, Adams & Read, 2005).

Significant main effects for binge frequency and alcohol problems were observed for negative alcohol expectancies. At baseline, students that more frequently engaged in binge drinking in the month prior to the study weighed the cons of alcohol use less heavily when making decisions about how much to drink. This finding supports the negative association between heavy drinking and perceived cons of alcohol use observed by Noar, Laforge, Maddock and Wood (2003). Conversely, students experiencing problems as a result of their alcohol use (i.e., students categorized as Mild, Moderate and High problems) had statistically higher Cons at baseline relative to students with no problems. Similarly, Cronce, Fairlie, Atkins and Lee (In press) observed positive associations between alcohol use, problems and negative alcohol expectancies.

Gender, baseline cigarette and marijuana smoking status moderated change in negative alcohol expectancies. As hypothesized, students reporting no cigarette use at baseline (Nonsmokers) weighed the cons of alcohol use more heavily when making decisions about how much to drink. Frequent smokers, with the exception of the final follow-up, maintained the lowest level of Cons. This result may offer an underlying cognitive explanation for Reed, Wang, Shillington, Clapp and Lange's (2007) finding that tobacco experimenters and smokers report greater alcohol consumption than nonsmokers. Specific to marijuana use, students that reported infrequent use at baseline maintained Cons that were greater than or roughly equivalent to that of nonusers. This finding provides partial support for the moderation hypothesis. Consistent with cigarette use, frequent marijuana smokers maintained the lowest level of Cons over time. At baseline, the predicted mean Cons score for Frequent Tokers was statistically lower than the predicted mean Cons score for Non- and Infrequent Tokers.

Review of plotted predicted means for Cons indicated that males and females started and ended the CBARR trial with small level differences. There was considerable overlap in 95% confidence intervals for predicted mean Cons scores at each follow-up. This finding suggests the male and female college students hold similar cognitions of negative alcohol expectancies over time which is surprising considering the vast evidence that males engage in heavier drinking and experience greater alcohol problems compared to females (Weitzman, 2004; Greenfield, Midanik & Rogers, 2000; Korcuska & Thombs, 2003). Admittedly, previous studies that have found meaningful gender associations have used measures of positive alcohol expectancies (CEOA; Fromme, Stroot, & Kaplan, 1993) that are dimensional (e.g., social enhancement, tension reduction), not a composite positive alcohol expectancy score like the one used in the present study.

II.C. Moderation of Treatment Effects on Change in Alcohol Expectancies

This study concluded with a series of linear mixed effects regression analyses to determine if treatment effects on change in alcohol expectancies were moderated by predictors that were determined to be significant in tests of two-way interaction effects. This analysis produced three significant findings for positive alcohol expectancies. The effects of treatment on change in Pros were moderated by gender, class year and baseline binge frequency. Students that received treatment, regardless of predictor subgroup (e.g., males vs. females, freshmen vs. sophomores) did not exhibit the gains in Pros that were observed for control students. These effects were present during the intervention period (from baseline to 6 months). There is also evidence that treatment was more effective for males who exhibited a gradual reduction in Pros from 6 months to 2 years post-baseline. Though not statistically greater, Pros for Treatment females increased slightly from 1.5 to 2 years.

The effect of treatment on change in Pros for Mild binge frequency students was not positive. Initially, from baseline to six months, AM Control and Treatment students that engaged in Mild binge drinking (1-2 episodes in the past month) experienced similar growth in Pros. From three months on, adaptive change favored AM Control students. The fact that students assigned to the treatment condition exhibited less adaptive change in Pros may suggests that the intervention helped these students acknowledge that their infrequent drinking behavior was not problematic and produced many positive effects. This explanation was offered by Carey, Carey, Maisto and Henson (2006) when their BMI intervention enhanced with a decisional balance exercise failed to outperform an assessment-only control condition in the reduction of heavy alcohol use by college students.

Finally, despite preventing increases in Pros from baseline to 6 months, treatment appears to have had undesirable effects. Students that received the intervention ended the trial with higher Pros than control students. This was apparent in a majority of comparisons. Control females, freshmen and sophomores, and Low, Moderate and High binge frequency drinkers all experienced reductions in Pros from 6 months to 2 years, ending the trial with a lower level of Pros relative to their counterparts in the Treatment condition. It is possible, having not received the intervention, that these control subgroups engaged in higher levels of drinking and experienced greater consequences that promoted the adoption of healthier cognitions of the positive aspects of alcohol use.

IV. Study Limitations

There are several limitations to this study. First, the CBARR trial was conducted at the University of Rhode Island from 2000-2002 and recruited few Hispanic, Black, Asian, or Native American participants. Due to an insufficient number of cases, ethnicity (Hispanic =1, Not Hispanice = 0) could not be evaluated as a predictor of change. Though race was included as a predictor, participants were reclassified into White and non-White categories with the underlying assumption that cognitions of alcohol expectancies for non-Whites are relatively homogenous. This may not be the case, however, ample research has found that White college students consume more alcohol and experience more problems compared to Hispanics and Blacks (O'Malley & Johnston, 2002; Del Boca, Darkes, Greenbaum & Goldman, 2004; Mounts, 2004; Weitzman, Nelson & Wechsler, 2003). Any significant findings involving race, which includes an interaction effect for change in Pros, must be interpreted with this in mind. In addition, the demographics of the URI student population have changed since 2000. The percentage of incoming freshmen that self-identify as students of color is nearly double that of student that participated in the CBARR trial. Findings involving race may not be generalizable to today's college-going population.

Second, several of the moderators measured on a continuous scale were converted to categorical variables. This includes binge-frequency, alcohol problems and peer influence. The decision to convert binge-frequency and alcohol problems to categorical variables stemmed from the fact that the distributions were positively skewed. This was especially the case for binge-frequency which was zero-inflated. Categorization of these two variables into Low, Mild, Moderate and High groups provided a simple alternative to performing a logarithmic transformation on the data. Similarly, peer influence scores were used to categorize participants into Low, Medium and High groups. The primary issue with this procedure is one of information loss (Altman, 2005). Further, use of the employed data-derived "cutpoints" (i.e., separating participants into roughly equal sized groups on the basis of scores) has been known to lead to bias in the interpretation of results (Royston, Altman & Sauerbrei, 2006). All are issues that would be more problematic had the decision been made to dichotomize these variables (Naggara, Raymond, Guilbert, Roy, Weill & Altman, 2011; Royston, Altman & Sauerbrei, 2006).

Third, all outcomes in the CBARR study were measured with self-report questionnaires which are subject to bias and reporting errors. This problem may be compounded by the fact that several of the selected predictors (e.g., parent alcoholism, binge frequency and alcohol problems) are measured retrospectively and/or deal with health-risk behaviors. Under these conditions, responders may find certain behaviors too difficult or sensitive to recall (Metch, Sprecher, & Cupach, 1991). In addition, participants may purposely under- or over-report a particular behavior because it is viewed as socially (un)desirable (Brener, Billy & Grady, 2003).

Lastly, all predictors are modeled in tests of conditional growth as time-invariant predictors. This works well for variables that do not change over time such as treatment condition, gender and race. The remaining covariates of Greek status, peer influence, parent alcoholism, binge frequency, alcohol problems, cigarette smoking status and marijuana smoking status are not static. These variables, like the dependent measures of alcohol expectancies, can also change over time. Modeling these variables as time-invariant predictors does not allow for an examination of the relationship between change in these variables over time and change in alcohol expectancies. It is the opinion of this author that the analyses completed in the present study serve as a necessary pre-requisite for more complex analyses involving dynamic predictors in tests of conditional growth.

V. Future Directions

This study of predictors of change in college freshmen and sophomore cognitions of alcohol expectancies addressed important questions regarding the development of positive and negative alcohol expectancies over time and meaningful factors influencing that development. Additional analyses were completed to determine if predictors moderated the effects of treatment on change in alcohol expectancies. As with any other study, this investigation raises additional questions. Several were presented earlier in light of the discussion on specific findings.

An obvious follow-up to this study would be to examine how change in alcohol expectancies relates to change in drinking and problem behaviors. As research on reciprocal determinism of expectations and alcohol use by college students would suggest, the relationship between expectancies and behavior is more dynamic, with each influencing the other at concurrent or even lagged time points. A follow-up study involving cross-lagged, dual trajectory or conditional growth modeling of expectancies with time-varying alcohol use and problems would shed light on the temporal associations of these factors. Further, the design of the CBARR trial permits a cross-lagged analysis of the relationship between alcohol expectancies and use during a time when college student drinking is increased. This would extend the findings of Sher, Wood, Wood and Raskin (1996). In short, interventions that facilitate change in cognitions related to substance use can only be considered effective if that change precipitates change in problem behavior (Webb & Sheeran, 2006)

Another important question, or series of questions, deals with three-way interaction effects between combinations of selected predictors and change in alcohol expectancies over time. In this study, the highest order three-way interaction effects involved treatment condition, time and a predictor found to be significant in tests of two-way interactions. The purpose of these analyses was to determine if treatment effects varied by levels of meaningful predictors. This analysis yielded three significant findings for Pros.

It is highly probable, given findings from studies on alcohol expectancies, use and problems, that combinations of selected predictors also moderate change in alcohol expectancies. A case can be made for examining the relations between gender and parent alcoholism (male X parent alcoholism X time) and gender and binge frequency (male X binge frequency X time). Sher, Wood, Wood and Raskin (1996) found that females with a family history of alcoholism perceived greater positive alcohol expectancies. Read, Wood, Lejuez, Palfai and Slack (2004) found that males that participate in heavy alcohol use perceived greater positive alcohol expectancies. These relationships can be analyzed with CBARR data. Additionally, an examination of the relationship between treatment, peer influence, binge frequency and change in alcohol expectancies could lend support to or disconfirm Carey, Henson, Carey and Maisto's (2007) finding that heavy drinking college students who frequently engage in social comparison are less likely to reduce heavy alcohol use after an intervention.

APPENDIX A

THE UNIVERSITY OF RHODE ISLAND
DIVISION OF RESEARCH AND ECONOMIC DEVELOPMENT

THINK BIG WE DO™

OFFICE OF RESEARCH INTEGRITY
70 Lower College Road, Suite 2, Kingston, RI 02881 USA
p: 401.874.4328 f: 401.874.4814 uri.edu/research/tro/offices/researchintegrity

FWA:	00003132
IRB:	00000599
DATE:	April 30, 2015
TO:	Robert Laforge, Sc.D.
FROM:	University of Rhode Island IRB
STUDY TITLE:	Predictors of change in college freshmen and sophomore cognitions of alcohol expectancies
IRB REFERENCE #:	669504-1
LOCAL REFERENCE #:	HU1415-148
SUBMISSION TYPE:	New Project
ACTION:	DETERMINATION OF NOT HUMAN SUBJECT RESEARCH
EFFECTIVE DATE:	April 30, 2015

Thank you for your submission of New Project materials for this research study. The University of Rhode Island IRB has determined this project does not meet the definition of human subject research under the purview of federal regulation 45 CFR 46 regarding human subject research at this time. Therefore, your project does not require Institutional Review Board (IRB) oversight. Any changes in focus of this project will require further review of the IRB.

If you have any questions, please contact us by email at researchintegrity@ds.uri.edu. Please include your study title and reference number in all correspondence with this office.

Andrea A. Rusnock

Andrea Rusnock, Ph.D
IRB Chair

APPENDIX B

<u>Decisional Balance for Alcohol Use</u>

The following situations represent different opinions, feelings and attitudes about drinking. HOW IMPORTANT to you are the following statements in your decisions about how much to drink, using the following five-point scale?

1. *Not at all important*
2. *Not very important*
3. *Somewhat important*
4. *Very important*
5. *Extremely important*
   - -8. Refused
   - -9. Don’t know/not sure

<u>Pros</u>

1. I feel happier when I drink.
2. It is easier to talk with someone I am attracted to after a few drinks.
3. Drinking helps keep my mind off problems.
4. Drinking makes me more relaxed and less tense.
5. Drinking helps me have fun with friends.
6. I am more sure of myself when I am drinking.

<u>Cons</u>

1. Drinking could get me in trouble with the law.
2. Drinking interferes with my ability to exercise.
3. Drinking too much could make me do things I regret.
4. Drinking too much can make me less attractive to others.
5. I am setting a bad example for others with my drinking.
6. Drinking too much can lead to many problems.

Citation:

Laforge, R.G. et al. (2005). *Cross-cultural validation of short forms of decisional balance and situational temptations for problem drinking in college populations*. Presented at the annual meeting of the Society for Behavioral Medicine, Boston, MA: April 15, 2005.

APPENDIX C

Peer Influence Scale

The next set of questions is about your FRIENDS and FAMILY. Please be aware that your friends and family have no way of knowing your answers to these questions.

1. How do most of your close friends feel about drinking?
   1. Strongly disapprove
   2. Disapprove
   3. Neither approve nor disapprove
   4. Approve
   5. Strongly approve
      -8. Refused
      -9. Don't know/not sure

2. How do most of your close friends feel about getting drunk?
   - See response options for question 1 above -

3. When your close friends drink, how much (on average) does each person drink?
   1. They don't drink
   2. 1 or 2 drinks
   3. 3 or 4 drinks
   4. 5 or 6 drinks
   5. More than 6 drinks
      -8. Refused
      -9. Don't know/not sure

4. How often does drinking go on where you live?
   1. Never or almost never
   2. Occasionally
   3. Only on weekends
   4. Almost every day
   5. Everyday (weekends and weekdays)
      -8. Refused
      -9. Don't know/not sure

5. When people where you live drink, how much does each person drink?
   1. None (there is no drinking where I live)
   2. 1 or 2 drinks
   3. 3 or 4 drinks
   4. 5 or 6 drinks
   5. More than 6 drinks
      -8. Refused
      -9. Don't know/not sure

APPENDIX D

College Alcohol Problems Scale – revised

Please describe how often you have had any of the following problems OVER THE PAST SIX MONTHS as a result of drinking alcoholic beverages. Please use the following five point scale:

1. *Never*
2. *Rarely*
3. *Sometimes*
4. *Often*
5. *Very Often*
   -8. Refused
   -9. Don't know/not sure

1. As a result of drinking, how often have you felt sad, blue or depressed?

2. As a result of drinking, how often have you engaged in unplanned sexual activity?

3. As a result of drinking, how often have you felt nervousness or irritability?

4. As a result of drinking, how often have you driven under the influence?

5. As a result of drinking, how often have you felt bad about yourself?

6. As a result of drinking, how often did you NOT use protection when engaging in sex?

7. As a result of drinking, how often did you have problems with appetite or sleeping?

8. As a result of drinking, how often were you involved in illegal activities associated with drug use?

Citation:

Maddock, J.E. et al. (2001). The college alcohol problems scale. *Addictive Behaviors*, *26*, 385-398.

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