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Evaluating a Brief Web-Based Prevention Intervention for Risky Alcohol Use Among College Students

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EVALUATING A BRIEF WEB-BASED PREVENTION INTERVENTION FOR RISKY ALCOHOL USE AMONG COLLEGE STUDENTS

A thesis submitted in partial fulfillment of the requirements for the degree of Master of Science at Virginia Commonwealth University

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Abstract

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The purpose of this study was to evaluate a brief, web-based alcohol prevention intervention program as a universal approach to addressing the range of alcohol behaviors present on college campuses. The sample of freshman college students recruited from Spit for Science (Dick et al., 2014) included 153 intervention participants, and 151 control participants matched on demographics and baseline alcohol variables. Hierarchical multiple regression, logistic regression, and moderated multiple regression were used to compare intervention and control participants on post-intervention alcohol variables. Treatment predicted lower alcohol use disorder (AUD) symptoms, particularly among baseline drinkers. For non-drinkers, the intervention was associated with a decreased likelihood of alcohol initiation. Family history moderated the intervention's effect on drinks per occasion and AUD symptoms, with family

history positive individuals responding better to the intervention. Readiness-to-change and concern for one's drinking were not supported as moderators, suggesting more research is needed to identify mechanisms of change.

Evaluating a Brief Web-Based Prevention Intervention for Risky Alcohol Use Among College Students

Across college campuses, heavy alcohol consumption and risky drinking practices are a prevalent concern. According to a national study of substance and alcohol use, 78% of college students have initiated drinking and approximately a third of college students (35.2%) consumed five or more drinks in one sitting within the prior two weeks (Johnston et al., 2015). Further, more than a tenth of college students (13%) greatly exceeded the standard threshold for binge drinking (defined as four or more drinks on one occasion for females or five or more drinks on one occasion for males), consuming 10 or more drinks on one occasion in the previous two weeks. The probability of experiencing negative outcomes, such as problems with school, emotional health problems, bodily harm or injury, and troubles with the law, is significantly elevated for individuals who endorse risky drinking practices (Hingson, Heeren, Winter & Wechsler, 2005; Lee, Maggs, Neighbors, & Patrick, 2011; Perkins, 2002).

Attending college is a unique contributing factor to the development of alcohol use behaviors, which is evident in the pronounced increase in alcohol consumption after high school among college students compared to same-age non-college peers. In a longitudinal study of substance use in adolescents and young adults, college students were less likely to drink alcohol in high school than their same-age non-college peers; however, upon entering adulthood, 63% of college students compared to 56% of non-college students endorsed annual and past month alcohol use (Johnston et al., 2015). Further, college students were more likely to report having been drunk in the prior month, endorsing a rate of 43%

compared to 34% non-college peers. Other studies have indicated that college students drink more and are more likely to experience clinically significant consequences of their drinking, despite being equally at risk for alcohol dependence (Slutske, 2005; Slutske et al., 2004). It seems that for young adults, the college environment is in and of itself a risk factor for problematic alcohol use.

Peer influences, easier access to alcohol, engagement in fraternity/sorority events, and increased independence are all factors that can contribute to the pattern of increasing alcohol use evident across the first year of college (Borsari, Murphy, & Barnett, 2007**)**. Approximately half of college students who enter college as non-drinkers will begin drinking before they reach 21 years of age (Lo & Globetti, 1995). These trends are alarming, particularly because we know that drinking practices established in college years set the stage for lasting drinking patterns across adulthood (Gotham, Sher, & Wood, 1997). However, heavy patterns of alcohol use present in college will not persist for all users through adulthood. Many individuals mature out of their risky patterns of use as they near the end of emerging adulthood, due in part to new responsibilities such as marriage and parenthood (O'Malley, 2004; Winick, 1962). Personality traits that play a role in rates of alcohol use, such as impulsivity and neuroticism, have also been shown to shift from adolescence to early adulthood (Littlefield, Sher, & Steinley, 2010). Our current knowledge of these and other factors that influence alcohol use is not sufficient to distinguish individuals who will mature out of their risky patterns of use versus those who will embark on a path of lifelong problematic alcohol use.

Universities are faced with the challenge of enacting programming to prevent or minimize the likelihood of negative alcohol-related outcomes among their students. Students

may experience harms related to alcohol use, such as missing classes, injury, risky sexual behavior and blacking out; however, they may not face the dependency and withdrawal symptoms popularly associated with alcoholism (Caldeira, et al., 2009; Wechsler, et al., 2002). Thus, traditional treatment programs for alcohol use disorders, such as 12-step programs, are often not applicable for this demographic (Kilmer & Geisner, 2013). Rather, many of the programs designed for college students incorporate evidence-based techniques such as motivational interviewing, cognitive-behavioral skills, social norms, and Personalized Normative Feedback (Kilmer & Geisner, 2013). These programs often use a harm-reduction strategy rather than encouraging students to abstain entirely from alcohol use (Neighbors, Larimer, Lostutter, & Woods, 2006). They also differ from more intensive 12-step programs in that they are often brief interventions that focus on one's own motivation for changing alcohol use behaviors. Brief alcohol interventions have been shown to be effective at reducing rates of alcohol consumption and preventing alcohol-related negative consequences among college students who exhibit risky drinking behaviors (Larimer & Cronce, 2007).

Despite recognition that college student alcohol use is a costly and dangerous problem, only 41% of universities require that their students complete an alcohol education program (Nelson, Toomey, Lenk, Erickson, & Winters, 2010). For the remaining schools that do not mandate alcohol education for their students, the opportunity to individually address alcohol use behaviors only arises after a serious problem has been identified. If a student were to engage in heavy alcohol use but avoid an infraction, he or she could continue their risky level of use without any understanding of the potential for negative consequences. A universal approach to alcohol prevention and intervention would allow schools to

intervene before sanctioned incidents occur. The need for universal prevention/intervention is further supported by the existence of a "prevention paradox" for college student alcohol use, whereby the heaviest drinkers represent a relatively small portion of all alcohol users (Weitzman & Nelson, 2004). Though these individuals are most at risk for alcohol-related harms, they are responsible for only a small portion of the total number of negative consequences that befall college students. There is a need to both delay the onset of alcohol initiation and prevent the increase of risky drinking behaviors among lower risk students. Reactionary strategies that identify only high-risk individuals for interventions are not sufficient to address the scope of alcohol-related consequences among college students.

There are three levels of prevention and intervention, the broadest of which, universal prevention, is designed to address an entire population of interest (i.e., all students at a university). With respect to alcohol use, universal programs generally aim to delay initiation in alcohol use among non-drinkers, prevent an increase of alcohol use among low-risk drinkers, and reduce alcohol use among heavy or high-risk drinkers. Selective prevention/intervention is the second level of classification. A selective approach targets individuals who are at elevated risk for problematic alcohol use due to characteristics such as family history, gender, or engagement in activities such as fraternities, sororities, or athletic teams. Individuals identified for a selective approach might not necessarily display problematic drinking behaviors, but instead are at risk for problems due to other known risk factors. The third and narrowest level is referred to as indicated prevention. Indicated prevention aims to address alcohol use among individuals who have exhibited problems with alcohol use, such as alcohol-related harms, or tolerance, that suggest they might be on a path towards alcohol abuse. Programs classified as indicated often employ individualized

techniques, such as in-person motivational interviewing, that are effective but time and cost intensive. Although technological advances mean that an individualized approach to alcohol intervention/prevention is possible at the universal level, many universities still employ methods for screening and preventing dangerous alcohol use among their students that have not been shown to be effective, such as alcohol education alone (Larimer & Cronce, 2007; Moskowitz, 1989; Winters, 2013; Winter et al., 2011). Incorporating evidence-based methods into online interventions can both improve the capacity to reach students and more comprehensively address risky use beyond reactionary methods, which mandate treatment only for sanctioned students.

Web-based Interventions

Web-based interventions are a useful tool for a universal approach preventing alcohol-related problems among college students. One perspective suggests that the cloak of the Internet may allow students to be more honest about their alcohol use and problems they may have encountered than in face-to-face interactions with university staff (Hester & Miller, 2006). Individuals might also be more likely to approach treatment in a low-risk format devoid of the stigmatization that exists in mental health treatment (Copeland & Martin, 2004). Importantly, they provide a relatively inexpensive, resource-sensitive, and easily disseminated solution to more costly in-person interventions.

There are also some challenges to address with web-based alcohol intervention and prevention programs. Skeptical students may worry about privacy and falsify their rates of alcohol use, particularly when under the legal drinking age. Such privacy concerns are important when establishing a web-based program for alcohol intervention and prevention, especially in light of the legality of use for those under the age of twenty-one. Furthermore,

the lack of face-to-face interactions inhibits the benefits of a therapeutic alliance (Taylor & Luce, 2003). The lack of direct contact with a practitioner means that reassurances of confidentiality are not possible. Another criticism of web-based alcohol intervention programs is that they are not as adaptable or customized as in-person interventions. However, as technology has advanced, more sophisticated approaches to tailoring online intervention programs are possible. Such programs can successfully adapt in-person interventions and have potential to incorporate interactive digital content that is perhaps uniquely possible with computer-based interventions.

Three specific techniques (tailored interventions, Personalized Normative Feedback, and Motivational Interviewing) are effective when adapted for web-based interventions. A fourth, alcohol education, works only in combination with other evidence-based techniques. These four alcohol intervention techniques, which have been adapted for use in web-based interventions, are discussed in detail.

Tailored interventions. Tailored interventions move beyond targeted interventions, which consider only surface level characteristics such as gender, ethnicity, participation in activities such as fraternities, sororities, and college sports (Bingham et al., 2011). Tailoring interventions to an individual's characteristics, personality traits, goals, motivation, and pre-existing risk factors has been shown to enhance the effectiveness of alcohol interventions. It is hypothesized that if an intervention more adeptly speaks to an individual's nuanced risk profile, her or she will be more responsive to the message of the intervention (Lustria, Cortese, Noar, & Glueckauf, 2009). This tailored approach has been shown to be effective when addressing factors such as biological level of response to alcohol (Savage et al., 2015; Schuckit et al., 2012; Schuckit et al. 2015), drinking motives (Canale, Vieno, Santinello,

Chieco, & Andriolo, 2015), and personality traits (Conrod, Castellanos-Ryan, & Mackie, 2011). Web-based tailored interventions have great potential to not only customize prevention and intervention to theory-driven risk factors, but also identify when maintenance strategies to prevent initiation or increase of alcohol use might be more appropriate for low-risk individuals (Dick & Hancock, 2015; Palfai, Winter, Lu, Rosenbloom, & Saitz, 2014).

Personalized Normative Feedback. Personalized Normative Feedback (PNF) is a type of tailored approach that involves collecting information about an individual's alcohol use behaviors and providing feedback about how their drinking compares to others in their population as well as information about healthy standards for alcohol use (Lewis & Neighbors, 2006). PNF is a tailored approach, in that a student's own rate of alcohol use, along with perceptions about college student alcohol use overall, are directly compared to established norms in order to correct misbeliefs about the prevalence of alcohol use. PNF can debunk overestimates of peer rates of consumption and the efficacy of this approach has been well documented in reviews (Carey, Scott-Sheldon, Carey, & DeMartini, 2008; Larimer & Cronce, 2007; Lewis & Neighbors, 2006). Furthermore, PNF has been successfully applied as both an in-person and computer-based intervention technique (Collins, Carey, & Sliwinski, 2002; Neighbors et al., 2010). In web-based versions, a participant reports their frequency and quantity of alcohol use and then receives a feedback form, which compares their level of use to population data matched on demographics. This can be immediately generated electronically, providing fast and informative feedback to participants about their alcohol use compared to others in their social world. The nature of the PNF technique is very well suited for computer-interventions, thus its comparable efficacy is logical.

Motivational Interviewing. Motivational Interviewing has emerged as a powerful tool for inciting behavior change in clinical samples of treatment seeking or non-treatment seeking mandated individuals. This highly client-centered technique facilitates the identification of problems through an empathetic approach aimed at identifying discrepancies, working through resistance, and promoting self-efficacy all while circumventing argumentative behavior (Miller & Rollnick, 1991; Rollnick & Miller, 1995). By assessing one's readiness to change, the clinician or program can adapt the intervention techniques to where they are in the stages of change. In-person applications of brief Motivational Interviewing for college students have been shown to reduce rates of drinking as well as harms related to risky drinking (Larimer & Cronce, 2007). Many alcohol intervention and prevention programs incorporate techniques from motivational interviewing. For example, in a web-based adaptation of the Brief Alcohol Screening and Intervention for College Students (Dimeff, 1999), students are asked to identify goals for their time in college. This is used to help students identify discrepancies between the consequences of their alcohol use and their goals for college. Motivational Interviewing is also frequently paired with some of the techniques previously mentioned, such as Personalized Normative Feedback and challenging expectancies.

Alcohol education. The most rudimentary approach to reducing alcohol use and related harms among college students involves the distribution of information about alcohol and its effects. This method presumes that college students misuse alcohol because they lack knowledge about its effects, such as the dangers and health risks associated heavy consumption (Larimer & Cronce, 2002). Building awareness and understanding of the effects of alcohol should in theory lead to a decrease in use. However, informational or

educational programs alone have consistently proven ineffective at reducing risky drinking and harms related to alcohol use (Larimer & Cronce, 2007; Moskowitz, 1989). Nevertheless, alcohol education programs are popular among universities (DeJong & Langford, 2002). They are easily adapted for web-based distribution and are often utilized for a universal approach to prevention. Despite these benefits, such programs are not effective at changing drinking behaviors and thus should not be relied upon as the sole tool for preventing risky alcohol use on college campuses. However, knowledge-based programs have shown positive results when used in combination with other techniques.

Efficacy of Web-based Interventions

Overall, reviews of web-based adaptations of alcohol intervention programs for college students show support for such programs compared to no treatment at all. For example, Elliot, Carey, and Bolles (2008) conducted a qualitative review of 17 randomized-controlled trials of computer-driven or web-based alcohol interventions for college students and found that these so-called "e-interventions" are effective at reducing some drinking behaviors compared to groups that only received assessments, particularly among high-risk or heavy drinking samples. In comparing e-interventions to interventions conducted on paper, they found similar rates of reduction in drinking measures across selective or indicated samples.

All three levels of prevention (universal, indicated, and selective) were represented in the studies reviewed by Elliot et al., but 11 of the 17 students included only high-risk or heavy drinking students. Among the remaining six studies, one study showed no effect of the intervention on drinking outcomes (Kypri & McAnally, 2005), four established a positive effect on knowledge, beliefs, or intentions but not consumption (Meier, 1988; Moore,

Soderquist, & Werch, 2005; Reis, Riley, Lokman, & Baer, 2000; Sharmer, 2001), and one study found a reduction in alcohol consumption only in students who were already drinking (Bersamin, Paschall, Fearnow-Kenney, & Wyrick, 2007). This trend of web-based program efficacy among only at-risk or heavy drinking samples shows a need to further explore preventive effects of interventions among population-based samples of college students.

Another review of computerized interventions compared in-person to computerized interventions using effect size calculations (Carey, Scott-Sheldon, Elliot, Bolles, & Carey, 2009). Their results suggest that short-term effects of such programs are comparable to in-person interventions, but longer-term results (e.g. 6 weeks to 1 year) are mixed, which suggests a need for more studies that evaluate the long-term effects of web-based interventions. However, 37 of the 48 samples included in the meta-analytic review only studied students who had already initiated drinking. Among the remaining studies, almost all programs were predominantly comprised of drinkers; therefore, the conclusions from this review may not apply to web-based interventions that employ a universal approach. For example, one study (Hustad, Barnett, Borsari, & Jackson, 2010) included a group of 245 abstainers and light users in their sample, but found that the treatment effects on consumption observed at the group level comparison (intervention v. control) did not hold among this low-risk group. It may be that certain individual factors such as baseline alcohol use and readiness to change may moderate the effects of web-based interventions, though these effects may only be discernable across time (Capone & Wood, 2009).

Moderators of Intervention Effectiveness

Readiness to change. There are a number of factors that have been explored as moderators of intervention effectiveness. Many of these factors reflect the degree to which a

given intervention is applicable to an individual's specific risk profile. In fact, tailored interventions can be seen as an effort to minimize the role of moderating variables by changing content based on important intervening factors. For example, motivation to change plays a key role in whether or not an individual alters their behavior as a result of intervention techniques. Accordingly, an individual who reports low readiness to change their behavior is less likely to reduce their alcohol use as a result of a brief alcohol intervention (Capone & Wood, 2009; Chiauzzi, Green, Lord, Thum, & Goldstein, 2005). Motivational Interviewing attempts to improve the likelihood of change by adjusting the target based on one's readiness to change (i.e., creating attainable goals for changing alcohol use behaviors).

Family history of alcohol use problems. Another possible moderating factor of intervention efficacy, absence or presence of family history of alcohol use problems, speaks to the heritable risk for problems with alcohol. Many interventions attempt to address this fundamental component of the development of problems with alcohol use by incorporating it into feedback about one's risk profile. As described, this may improve treatment efficacy by tailoring the feedback to risk factors that apply specifically to that individual. In addition, students with a family history of alcohol use problems may be more amenable to intervention in general due to heightened awareness of the issue and firsthand experiences with the deleterious effects of alcohol abuse. Though the degree to which responsiveness to an intervention depends upon family history has not been well researched, there is some evidence that suggests female college students who self-report positive family history of alcohol use problems responded better to a motivation enhancement intervention (LaBrie, Feres, Kenney, & Lac, 2009; LaBrie et al., 2008). Exploring the role of moderating variables

such as readiness to change and family history can both elucidate the mechanism by which an intervention is effective and highlight potential areas for tailoring intervention to improve outcomes.

Brief Alcohol Screening and Intervention for College Students

One specific intervention that incorporates a combination of evidence-based components is the Brief Alcohol Screening and Intervention for Colleges Students, or BASICS (Dimeff et al., 1999). BASICS is a manualized preventive intervention designed for college students. The program is described as an indicated as opposed to universal approach to alcohol intervention, meaning that it is designated for individuals identified as at risk for problems with alcohol. BASICS is indicated for (1) heavy drinking students, (2) students who are at risk for alcohol-related consequences, or (3) students who have already experienced negative effects of heavy drinking (Dimeff, 1999). The standard protocol for BASICS is administered across two in-person sessions with a college administrator or clinician, including a computerized or web-based alcohol assessment and Personalized Feedback Profile (PFP). Though this intensive in-person protocol is appropriate and effective for individuals with alcohol problems, the web-based PFP alone contains elements important for reducing alcohol use regardless of risk status. To further illustrate the utility BASICS as a universal approach to prevention/intervention, the standard BASICS protocol is described first, followed by details of the web-based adaptation.

The standard BASICS protocol is administered over two sessions, each of which lasts approximately one hour. The first session is comprised of a clinical interview used to gather information about the student's drinking behavior in a non-judgmental, conversational style. Using motivational interviewing techniques, the clinician gauges the student's beliefs about

drinking and their goals for college (Miller & Rollnick, 1991). The first session also explores harms related to alcohol use that the student might have experienced, strategies that they have used to limit their drinking, and readiness to change their behavior. Another component of the first session involves quantifying the student's drinking behaviors, which is achieved through both a discussion their consumption with the clinician and a computerized assessment of alcohol consumption. Importantly, the clinician aims to build rapport with the student in this first session so as to facilitate optimal delivery of the information in the later feedback session.

In the second session, the clinician delivers personalized feedback about the student's reported alcohol-related attitudes and behaviors and distributes the PFP handout from the computerized assessment for the student to take home after the session. Similar to the first session, the clinician is careful to avoid judgmental or proscriptive language that would insinuate to the student that they are being told what to do. The feedback attempts to dispel any myths about college student alcohol use by using the beliefs about drinking described by the student in the first session. There are a number of informational components included in the feedback: the student's caloric intake due to alcohol is summarized, exercise required to burn the calories due to alcohol, and money spent on alcohol. The student is advised on strategies to reduce their peak Blood Alcohol Content (BAC), and the student's drinking patterns is compared to normative data from their own university. The clinician uses a conversational and educational approach in providing this feedback and the student is encouraged to ask questions at any time. Finally, each section of the feedback form is accompanied by an explanatory paragraph so that the student can continue to process the information after the session concludes.

The BASICS program has been thoroughly evaluated as a selective or indicated prevention program and there is ample evidence to suggest that BASICS is an efficacious intervention for reducing alcohol consumption among heavy drinking and at-risk college students (Dimeff & McNeely, 2000; Murphy et al., 2001). In a systematic review of the efficacy of BASICS, Fachini et al. (2012) identified 18 studies that met requirements for inclusion in a meta-analysis. Using a random-effects model to determine difference between means while controlling for heterogeneity across the samples, their results showed a reduction in alcohol consumption of −1.50 drinks per week with 95% CI [−3.24, −0.29] and alcohol-related problems of −0.87 with 95% CI [−1.58, −0.20] when compared to that of control group participants. These strong effects were measured at one-year follow up assessments, but some long-term studies suggest sustained effects on alcohol consumption and negative consequences at both 2-year (Baer, Kivlahan, Blume, McKnight, & Marlatt, 2001; Marlatt et al., 1998) and 4-year follow-ups (Borsari & Carey, 2000). Evidence in support of BASICS is so robust that it has been identified by the Substance Abuse and Mental Health Services Administration (SAMHSA) as a

model evidence-based indicated prevention program for heavy drinking college students.

Web-based adaptations of BASICS consolidate all components of the intervention into a computerized assessment and electronically-delivered Personalized Normative Feedback form. First, students complete an assessment that includes questions about demographic characteristics, frequency of alcohol and other drug use, family history of problem alcohol/drug use, alcohol expectancies, alcohol-related consequences, and harm reduction strategies. Peak BAC is calculated in the web-based assessment using the consumption measures; students are provided with this calculation and advised that a BAC above .2 can result in blackouts, injuries, and other negative consequences. Motivational components include asking students to identify their goals for college, rate the importance of changing their drinking habits, and report their confidence in their ability to change their drinking habits. Immediately after completing the assessment, students are provided with a link to download their Personalized Feedback Profile (PFP). This form incorporates the information provided in the assessment with normative data from their own university, fulfilling the Personalized Normative Feedback component of BASICS. Additional personalized risk factors, such as BAC, time it takes for alcohol elimination (time until sober) after a heavy drinking episode, caloric intake due to alcohol, and reflection of negative alcohol-related consequences are addressed in the PFP. Each component of the PFP is accompanied by a non-judgmental description of these risk factors as well as strategies for changing behavior when appropriate. Finally, students are encouraged to evaluate their goals for college and identify how their alcohol use might impact those goals.

Research also supports the efficacy of web-based adaptations of the BASICS program. LaBrie et al. (2013) conducted a randomized controlled trial to compare the efficacy of a "web-BASICS" program compared to PNF and an assessment only control. In their large sample (N=1663) of past month binge drinking college students at two west-coast universities, they found that the web-BASICS condition and the PNF condition produced similar reductions in alcohol consumption compared to the assessment-only control condition. When comparing web-BASICS to controls, they found a reduction in drinking days and maximum drinks, but no effect on alcohol-related problems. Saitz et al. (2007) evaluated a minimal and an extensive version of a brief web-based intervention modeled after BASICS among "unhealthy" college drinkers, defined as scoring 8 or higher on the Alcohol Use Disorder Identification Test (Fleming, Barry, & McDonald, 1991). They found significant reductions in drinks per week and heavy drinking episodes among female participants at follow-up. Further, the incidence of unhealthy drinking was reduced by 15% among males and 33% among females.

Brief Interventions as a Universal Approach to Prevention

Whereas there is sufficient evidence for BASICS as an indicated and selective prevention program, it has not been well researched as a universal program. Some studies show support for the use of brief interventions among low-risk or non-drinking college students, while others either show an absence of effect or worse, iatrogenic effects that result in potentially harmful increases in risky drinking behaviors (Werch & Owen, 2002). Thus, the importance of this research is twofold: (1) to explore opportunities for minimizing alcohol harms among all university students, (2) to ensure that employing prevention strategies with low-risk and non-drinking students does not contribute harm. With these

principles in mind, two prior studies of universal prevention strategies guide the theory behind the hypotheses for the present study.

First, a recent study specifically set out to investigate the effects of a brief, personalized feedback intervention when applied campus-wide as a universal approach to prevention (Palfai et al., 2014). Using a population approach to recruitment, Palfai et al. invited freshman students to take part in an assessment about alcohol use behaviors and then randomized participants to intervention and control groups. They aimed to maximize the beneficial effects of the intervention by doubling the size of the intervention group who received alcohol-related feedback compared to the control group who received general health feedback. The researchers did not find differences in alcohol consumption and risky drinking practices between intervention and control group participants at follow-up. They did however find that the intervention was protective against the initiation of alcohol use among baseline non-drinkers, which is consistent with results found in two other studies of prevention effects on non-drinking college students (Larimer et al., 2007. Wood et al., 2010).

Second, in a randomized clinical trial of a universal personalized feedback prevention program, Larimer et al. (2007) underscored the importance of examining the baseline characteristics of a university-wide sample for potential floor effects with respect to alcohol consumption and negative alcohol-related consequences. Larimer et al. found small but significant effects for past month drinking days, past year drinking days, and number of drinks per week as a function of the intervention, but the same trend did not hold for alcohol-related negative consequences. The authors posited that this might have been due to a relatively low average number of negative consequences at baseline among their university-wide sample. A sample predominantly comprised of light drinkers and abstainers will

respond differently than an at-risk or treatment-seeking sample, thus reductions in negative consequences and/or consumption are not necessarily realistic expectations for the outcome of the intervention. Indeed, both groups in the Larimer et al. study showed mean increases on measures of frequency and quantity; however, the intervention program affected the expected drinking trajectory such that the increases observed in the intervention group were significantly smaller than that of the control group. Therefore, an effective prevention/intervention program among a sample of participants with highly heterogeneous alcohol use behaviors might be expected to show maintenance of low levels of use and alcohol-related harms rather than a reduction from their already low baseline levels.

Purpose of This Study

The present study evaluated a web-based alcohol intervention program available for use at a large, public university in U.S that did not mandate alcohol education for its students. Freshman college students were enrolled in an online adaptation of the Brief Alcohol Screening and Intervention for College Students (BASICS) at the start of their second semester in college and their post-intervention drinking behaviors (approximately 30 days later) were compared to that of a control group that received no intervention (Dimeff, 1999). To investigate the utility of BASICS as a universal approach to alcohol intervention and prevention, three research aims and six hypotheses were explored in this study.

Research Aim 1. We examined whether completing the BASICS Feedback program was associated with differences in drinking behaviors in the spring semester.

Hypothesis 1a. We predicted significantly fewer drinking days over the past month and typical number of drinks consumed per occasion among students who completed the BASICS Feedback program compared to matched control participants.

Hypothesis 1b. We predicted significant differences in post-intervention alcohol use disorder symptoms between students who complete the BASICS Feedback program and individuals in the control group, with individuals who participated in the intervention reporting fewer alcohol use disorder symptoms.

Hypothesis 1c. We hypothesized that students in the intervention group who had not yet initiated drinking in the fall semester were less likely to initiate alcohol use in the spring semester than individuals in the control group.

Research Aim 2. We explored the role of individual differences in alcohol use and family history on the effectiveness of the intervention. Because BASICS was originally

designed to target risky drinkers, we tested for variations in post-intervention alcohol variables according to baseline alcohol variables and family history of alcohol use problems.

Hypothesis 2a. We predicted that students with higher levels of baseline alcohol consumption and alcohol use disorder symptoms would show greater reductions of post-intervention alcohol consumption and alcohol use disorder symptoms than students with lower levels of baseline drinking and symptoms.

Hypothesis 2b. We hypothesized that students in the intervention group who reported a family history of alcohol use problems would show greater reductions in alcohol consumption and alcohol use disorder symptoms than students who did not report a family history of alcohol use problems.

Research Aim 3. We examined whether components of the intervention (readiness to change and level of concern for one's own drinking) moderated the association between alcohol consumption at the time of the intervention and alcohol consumption 30 days post-intervention.

Hypothesis 3. We expected changes in post-intervention alcohol consumption to vary according to level of concern for one's own drinking and readiness to change, with greater reductions shown among individuals who reported high levels of concern and high readiness to change compared to students lower on those respective measures.

Methods

Participants

Participant recruitment. Participants in this sample were recruited from a larger university-wide longitudinal study entitled "Spit for Science," aimed at understanding genetic and environmental influences on the development of problems with alcohol use,

other substance use, and emotional health in college students (Dick et al., 2014). The Spit for Science study, which was approved by the Institutional Review Board at Virginia Commonwealth University, invited all freshman students age 18 and older to complete an online survey at the beginning of their first semester for which they received $10 in compensation. Among those invited to participate, 2022 (59%) completed the 15-30 minute survey about alcohol use, substance use, peers, family, mental health, personality, physical activity, and school and community activities. Individuals who completed the survey and picked up their payment were invited to take part in the genetic component for an additional $10 in compensation. Of those who collected their survey payment (N=1934), 96% also provided a DNA sample. The genetic component was not included in the analyses of the present study and is not discussed further.

A subset of participants who completed the Spit for Science survey were invited to take part in a smaller study at the beginning of the spring semester aimed at evaluating the effectiveness of the online alcohol intervention program. The participants invited to enroll in this study were randomly selected from the larger pool of Spit for Science participants. There were no specific inclusion criteria for the study, which aligns with the goal to evaluate the effectiveness of a brief intervention using a universal (including all students) rather than a targeted approach (limited to heavy drinking or at risk students). However, a group of Spit for Science participants (N=237) that participated in another alcohol intervention study were excluded from eligibility (Savage et al., 2015). Following approval from Virginia Commonwealth University's Institutional Review Board and informed consent procedures, a total of 797 individuals were invited to participate, of which 313 (39.3%) expressed interest and 180 (22.6%) completed the study. Participants in the intervention study received $10 in

compensation. The enrolled sample consisted of 124 females (68.5%), and the self-reported race/ethnicity of the participants was 19.3% Asian, 17.7% Black/African American, 5.6% Hispanic/Latino, 8.3% more than one race and 48.1% White. In comparison to the demographic characteristics of the broader Spit for Science sample, the intervention study sample (treatment and control groups combined) had a higher proportion of females, and individuals who self- reported race/ethnicity as Asian were overrepresented in the intervention study sample (22.4% in the intervention, 15.4% in Spit for Science; $z = 3.05$, $p =. 001$, one-tailed).

Selection of control participants. In order to determine if changes in drinking were attributable to the intervention program, we selected a group of control participants who completed both the fall and spring Spit for Science surveys, but did not complete the intervention study. Individuals were excluded from eligibility for the control group if they reported completing an alcohol intervention program, or if they took part in the intervention study tailored to level of response to alcohol (Savage et al. 2015). Control participants were matched to intervention participants based on ethnicity, sex, and fall alcohol variables (number of drinking days per month, typical drinks consumed per occasion, and maximum number of drinks in 24 hours). There were no significant differences between intervention and control participants on the key variables including alcohol consumption variables, ethnicity, age, and sex.

Procedure

Data collection. Study data were collected and managed using Research Electronic Data Capture (REDCap), which is a secure, web-based application hosted at the university designed to support data capture for research studies (Harris et al., 2009).

Assessment of alcohol use behaviors. Alcohol use behaviors were assessed for both intervention and control participants in the fall (Time 1) and spring (Time 2) semester Spit for Science surveys. Alcohol use behaviors assessed in these surveys included typical number of days drinking per month, usual number of drinks per occasion, maximum drinks in 24 hours (lifetime maximum for fall; used for matching), and DSM-5 Alcohol Use Disorder symptoms (lifetime symptoms for fall; symptoms since beginning college in the spring survey). Ninety-three percent of the intervention study participants completed the Spit for Science alcohol measures at Time 2, which was administered approximately one month after the intervention. Control participants were only selected if they completed the spring Spit for Science survey, resulting in a 100% completion rate for control participants at Time 2. *Figure 1* shows an overview of the study timeline and measures collected at each time point**.**

Alcohol prevention intervention program. The Brief Alcohol Screening and Intervention for College Students (BASICS) is an evidence-based intervention that has been adapted to an online format, entitled BASICS Feedback, in order to make it more accessible to broad audiences (Bewick et al., 2010; Dimeff, 1999; LaBrie et al., 2013; Saitz et al., 2007). The program aims to reduce risky behaviors and negative consequences related to alcohol use in a confidential manner free from judgment. In BASICS, participants complete a 15-20 minute assessment about their perceptions of and behaviors related to alcohol use and substance use, as well as personal goals for their time in college. This information is then used to create a Personalized Feedback Profile, which is provided to participants electronically immediately after completing the assessment. The Personalized Feedback Profile applies several evidence-based techniques for changing drinking behaviors such as

normative feedback, motivational interviewing, and readiness to change. Participants from the Spit for Science project were invited to complete the BASICS program in January of their spring semester, which was approximately five months after the initial assessment. Upon providing informed consent, participants in the intervention study were presented with a link to complete an online "alcohol education" program (BASICS Feedback). The BASICS program data was collected anonymously and utilized only to construct the Personalized Feedback Profile. Participants were assured of the confidentiality of their responses.

Upon completion of the BASICS Feedback program, participants were asked to complete a brief survey in REDCap to assess their experience with the program and the Personalized Feedback Profile. Participants responded to fidelity measures to verify that they had indeed completed the BASICS Feedback program. Lastly, participants provided a measure of their readiness to change their drinking behaviors and their level of concern for their own drinking.

Measures

Measures of demographic characteristics, alcohol use behaviors, and family history of alcohol use problems were assessed in both intervention and control participants through the Spit for Science surveys. Readiness to change, level of concern for one's own drinking, and fidelity measures were assessed only in intervention participants. An illustration of study procedures and assessment time points is also provided for clarity (*Figure 1*).

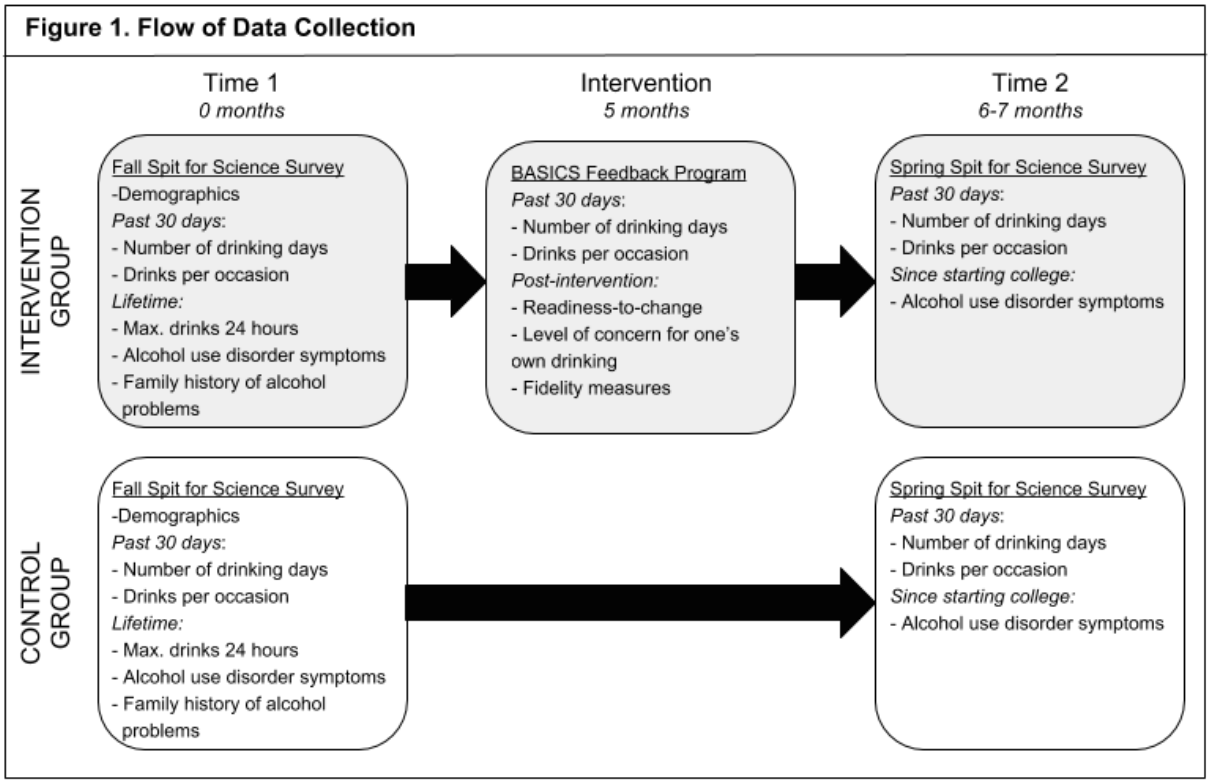

Figure 1. Flow of Data Collection. The top row of boxes describes the measures for the intervention group. The bottom row of boxes describes the corresponding measures assessed in the control group.

Demographics. A number of demographic variables were assessed in the Spit for Science fall survey in order to gain insight into the composition of the sample. For the present study, self-reported race/ethnicity, gender, and age were included in the analyses.

Alcohol use behaviors. Items measuring alcohol use behaviors were assessed at Time 1 and Time 2 for both intervention and control group participants. Participants who endorsed drinking alcohol at least once in their lifetime were asked to report the age at which they began to drink regularly and the age of first intoxication. These items established age of initiation, which has been shown to be associated with problem drinking in adulthood (DeWit, Adlaf, Offord, & Ogborne, 2014; Guttmannova et al., 2011; Hawkins et al., 1997).

After establishing initiation, two items from the Alcohol Use Disorder Identification Test (AUDIT) were used to assess how much and how often an individual drinks alcohol (Babor & Grant, 1989). In an evaluation of the psychometric properties of this measure, it was shown to have high reliability and moderate predictive validity of high-risk drinking among a sample of college students (Fleming et al., 1991; DeMartini & Carey, 2012).

A symptom checklist for DSM-5 Alcohol Use Disorder (AUD) was used to establish a sum score for the number of symptoms of an AUD and determine if a participant met diagnostic criteria for an AUD. In the fall semester, these items addressed lifetime criteria for AUDs whereas the spring semester addressed the time since initiating college. The specific items were adapted from the DSM-IV criteria used in the Semi-Structured Assessment for the Genetics of Alcoholism (SSAGA), which has been established as a reliable measure of problem alcohol use (Bucholz et al., 1994). The questions asked participants to indicate how often they experienced problems indicative of risky alcohol use such as, missing school or work because of drinking alcohol, continuing to drink even though it caused problems in a relationship, experiencing strong cravings or urges to drink, building tolerance to alcohol, drinking or becoming drunk unintentionally, reducing important activities because of drinking, experiencing withdrawal symptoms, and being unable to remember things that you did or places you were when while drinking.

Family history of alcohol use disorders. Participants indicated whether or not they believe their mother, father, or sibling has ever had a problem with alcohol use in the fall Spit for Science survey. Responses were dichotomized to represent the absence (score of 0) or presence (score of 1) of family history of AUDs.

Measures assessed in the intervention group. Individuals in the intervention group were asked to complete a brief questionnaire immediately after completion of the intervention. These items were not assessed in control group participants.

Alcohol consumption. The two AUDIT items measuring frequency of alcohol use and quantity of alcohol consumed per occasion were assessed in the intervention participants immediately after completing the BASICS Feedback program.

Readiness to change and concern for one's drinking. Participants in the intervention group answered eight items immediately after completing the brief intervention that assessed their reaction to the information on their Personalized Feedback Profile. Participants were asked to identify how surprised they were by the way their drinking compared to that of other students at their school and the amount of time it takes to get sober after their heaviest reported drinking period. Response options ranged on a scale from 1 to 5 where 1 was "not at all surprised," 3 was "moderately surprised," and 5 was "completely surprised." Likelihood of changing behavior as a result of the information on the feedback form was assessed using two items. The first item asked participants to identify on a scale from 1 to 5 how likely they were to attempt to reduce their peak Blood Alcohol Content (BAC). Participants also self-reported their level of concern about their own drinking on a scale ranging from 1 to 5, where 1 was "not at all concerned," 3 was "moderately concerned, and 5 was "completely concerned."

Fidelity measures. In order to ensure that participants in the intervention group completed the program as instructed, they were asked to respond to two fidelity items. These items were included in the brief survey that participants were instructed to complete immediately after the intervention. First, participants were asked to enter a component of

their Personalized Feedback Profile that indicated how they might know it was time to change their drinking. Second, participants were asked to enter a code phrase embedded into the last page of their Personalized Feedback Profile. These items were used to ensure that participants downloaded and read their Personalized Feedback Profile. Participants who incorrectly entered the correct code phrase were excluded from the analyses due to presumed failure to comply with study procedures (n=7).

Data Analysis

Data Preparation and Preliminary Analyses

To ensure that intervention and control groups were in fact similar on key characteristics at the baseline assessment, t-tests and chi-squared tests were conducted to evaluate their correspondence on gender, ethnicity, age and measures of frequency and quantity of alcohol use. Further, comparisons between the sample of the present study (intervention and control combined), and the overall Spit for Science sample were conducted to evaluate the representativeness of the intervention sample compared to the larger study. All analyses were completed using SPSS Statistics, version 23 (SPSS, Chicago, IL). Participants were allowed to decline to answer any item in the survey by selecting the response "I choose not to answer." Branching logic used in the survey administration allowed participants to skip out of sets of items that did not apply to them. For example, participants who had never had a drink of alcohol were not administered the alcohol consumption or alcohol use disorder items. In order to retain these participants in analyses, their values for such items were presumed zero and recoded accordingly. All other missing data was excluded list-wise. The effects of gender and race/ethnicity were controlled for in the analyses.

Statistical Analyses

Aim 1 analyses. These analyses examined whether the BASICS Feedback program was associated with differences in spring semester (Time 2) after controlling for fall semester (Time 1) drinking, gender, and race/ethnicity. All variables were examined for normality. Alcohol consumption variables and alcohol use disorder variables were log-transformed to reduce the effects of non-normality. Race/ethnicity was dummy coded, with white serving as the reference group. Hierarchical multiple regression was used to determine if group assignment (BASICS or control) significantly predicted Time 2 alcohol consumption and AUD symptoms over and above the effects of covariates. We also conducted a logistic regression in order to evaluate the preventive effects of the BASICS Feedback program among non-drinkers. Assignment to either the BASICS Feedback program or the control group was used to predict the likelihood that a non-drinker initiated alcohol use in the spring semester.

Aim 2 analyses. We hypothesized that individual differences in baseline drinking and family history of alcohol use disorders contributed to the effectiveness of the intervention. To test this hypothesis, Time 1 drinking was examined as a moderator of the intervention to predict spring drinking while controlling for fall drinking and covariates. As previously mentioned, the authors of the BASICS manual stated that the program was specifically designed for college students who engage in heavy drinking, have experienced negative consequences as a result of their drinking, or who are at elevated risk for experiencing negative alcohol-related consequences. Conducting this moderation analysis allowed us to investigate whether the effectiveness of the intervention at reducing alcohol use rates varied according to baseline drinking rate reported in the fall semester (Time 1).

Similarly, family history was tested as a moderator of the relationship between treatment assignment and Time 2 alcohol variables.

Aim 3 analyses. We expected that among intervention participants, readiness to change and concern for their drinking would play a role in the effectiveness of the intervention at reducing alcohol consumption 30 days later. To explore this interaction, we conducted a multivariate regression with readiness to change and level of concern for one's own drinking as moderators of the relationship between treatment assignment and alcohol consumption 30 days later. These factors (readiness to change and level of concern) were examined in separate models.

Results

Descriptive Analyses

Demographics. Descriptive characteristics of the sample retained for analyses are outlined in Table 1. There were no significant differences between intervention and control participants on demographic characteristics, which was expected due to the matching procedure used to select control group participants. Average age was 18.40 (SD = 0.35) for intervention participants and 18.45 (SD = 0.32) for control participants. Females represented 60% of both the intervention and control groups. Approximately half of the sample self-reported ethnicity as white (50% for intervention group; 51% for control group). Respectively, the remainder of the intervention and control groups samples were 22% and 23% Asian, 21% and 21% African American, and 7% and 5% Hispanic/Latino.

Table 1.

Descriptive Characteristics For Intervention and Control Group Participants

Variable	Intervention Group n = 153	Control Group n = 151	t/z (p)
Age (mean [SD])	18.40 (0.35)	18.45 (0.32)	-1.24 (.22)
Sex (*n* [%])			
Female	105 (69)	104 (69)	0.05 (.96)
Race/Ethnicity (*n* [%])			
Asian	34 (22)	34 (23)	-0.06 (.95)
Black/African American	32 (21)	32 (21)	-0.06 (.95)
Hispanic/Latino	10 (7)	8 (5)	0.46 (.65)
White	77 (50)	77 (51)	-0.12 (.91)
Initated alcohol use (*n* [%])			
Fall drinker	86 (56.2)	85 (56.3)	
Spring drinker	110 (71.9)	118 (78.1)	
Alcohol use (mean [SD])			
Fall drinking days	1.63 (3.40)	1.37 (2.80)	0.75 (.46)
Spring drinking days	1.91 (2.91)	1.98 (3.00)	-0.21 (.83)
Fall drinks per occasion	1.66 (2.40)	1.71 (2.44)	-1.90 (.85)
Spring drinks per occasion	2.19 (2.40)	2.47 (2.45)	-1.02 (.31)
Fall AUD symptoms	1.71 (2.70)	1.90 (3.10)	-0.58 (.56)
Spring AUD symptoms	2.23 (2.73)	2.60 (3.05)	-1.00 (.32)
Family History of alcohol problems (*n* [%])			
Mother, Yes	10 (6.5)	6 (4.0)	1.00 (.32)
Father, Yes	27 (17.6)	28 (18.5)	-.20 (.84)
Any parent, Yes	29 (19.0)	30 (19.9)	-.20 (.84)

Note. Total N = 304. Age is calculated in years for Freshman year. Drinking days and drinks per occasion were reported on past 30 days use. Alcohol use disorder (AUD) symptoms were reported on lifetime in the Fall and since starting college in the Spring.

As seen in Table 2, we also conducted comparisons of descriptive data from our sample to the larger Spit for Science. Demographically, our sample was significantly younger than the Spit for Science sample overall, though average age was still between 18 and 19 for both samples. Females and individuals who self-reported race/ethnicity as Asian were overrepresented in our sample. Across all alcohol variables, the Spit for Science sample was significantly higher than the alcohol intervention sample. There were no differences in family history of alcohol problems.

Table 2.

Comparison of Descriptive Statistics Between the Alcohol Intervention Study and the Spit for Science Study

Variable	Alcohol Intervention *n* = 304	Spit for Science *n* = 151	*t*/*z* (*p*)
Age (mean [SD])	18.43 (.33)	18.56 (.48)	**4.59 (<.001)**
Sex (*n* [%])			
Female	209 (68.8)	1511 (63.1)	**2.00 (.05)**
Race/Ethnicity (*n* [%])			
Asian	68 (22.4)	392 (16.3)	**2.65 (.008)**
Black/African American	64 (21.1)	478 (20.0)	.48 (.63)
Hispanic/Latino	18 (5.9)	137 (5.7)	.16 (.87)
White	154 (50.7)	1173 (48.8)	.61 (.54)
Initated alcohol use (*n* [%])			
Fall drinker	171 (56.3)	1490 (62.0)	**-6.23 (<.001)**
Spring drinker	228 (75)	1417 (81.2)	**-2.76 (.006)**
Alcohol use (mean [SD])			
Fall days drinking	1.50 (3.11)	2.21 (3.35)	**3.43 (<.001)**
Spring days drinking	1.94 (2.95)	2.83 (3.69)	**3.94 (<.001)**
Fall drinks per occasion	1.68 (2.42)	2.49 (2.52)	**5.23 (<.001)**
Spring drinks per occasion	2.33 (2.43)	2.95 (2.58)	**3.89 (<.001)**
Fall AUD symptoms	1.81 (2.90)	3.13 (3.63)	**6.00 (<.001)**
Spring AUD symptoms	2.40 (2.89)	2.87 (3.46)	**2.21 (.03)**
Family History of alcohol problems (*n* [%])			
Mother, Yes	16 (5.2)	194 (8.1)	-1.73 (.084)
Father, Yes	55 (18.1)	489 (20.3)	-.93 (.35)
Any parent, Yes	59 (19.4)	553 (23.6)	-1.42 (.16)

Note. Alcohol intervention study sample was combined to include both intervention and control participants. Age is calculated in years for Freshman year. Drinking days and drinks per occasion were reported on past 30 days use. Alcohol use disorder (AUD) symptoms were reported on lifetime in the Fall and since starting college in the Spring.

Alcohol variables. Means and standard deviations for alcohol variables in the fall and spring semester are displayed in Table 1. Due to the matching procedure, baseline drinking characteristics of intervention and control group participants were very similar. In the fall semester, intervention participants averaged 1.63 (SD = 3.4) drinking days per month, 1.66 (SD = 2.40) drinks per occasion, and 1.71 (SD = 2.70) alcohol use disorder (AUD) symptoms. Control group participants reported an average of 1.37 (SD = 2.80) drinking days per month, 1.71 (SD = 2.44) drinks per occasion, and 1.90 (SD = 3.10) AUD symptoms in

the fall semester. Both groups showed significant increases in all alcohol variables from the fall to the spring semesters; however, there were no significant differences between groups. Intervention participants increased to 1.91 (SD = 2.91) drinking days, t (146) = 3.33, p = .001, 2.19 (SD = 2.40) drinks per occasion, t (143) = 4.69, $p < .001$, and 2.23 (SD = 2.73) AUD symptoms, t (128) = 2.46, p = .02, while control participants increased to 1.98 (SD = 2.80) drinking days, t (143) = 4.84, $p < .001$, 1.71 (SD = 2.44) drinks per occasion, t (137) = 5.31, $p < .001$, and 2.60 (3.05) AUD symptoms, t (124) = 5.60, $p < .001$.

Displayed in Table 3, we compared fall and spring semester alcohol use variables in baseline drinkers and non-drinkers according to treatment assignment (intervention or control). Among baseline drinkers, the intervention group displayed significantly fewer spring semester AUD symptoms compared to the control group, t (169) = -2.39, p = .02. Among baseline non-drinkers, we observed no significant differences on pre or post-intervention alcohol use variables.

Table 3.

Comparison of Alcohol Variables and Family History between Intervention and Control Participants according to Baseline Drinking Status

	Baseline Drinkers *n*=171 (56.3%)			Baseline Non-drinkers *n*=128 (42.1%)		
Variable	Intervention *n*=86	Control *n*=85	*t*/*z* (*p*)	Intervention *n*=86	Control *n*=85	*t*/*z* (*p*)
Alcohol Use (mean [SD])						
Fall drinking days	2.87 (4.10)	2.42 (3.37)	.78 (.44)	-	-	-
Spring drinking days	2.91 (3.33)	3.19 (3.51)	-.54 (.59)	.62 (1.44)	.43 (.80)	.92 (.36)
Fall drinks per occasion	2.94 (2.54)	3.15 (2.53)	-.54 (.59)	-	-	-
Spring drinks per occasion	3.32 (2.48)	3.70 (2.29)	-1.02 (.31)	.75 (1.22)	.90 (1.63)	.59 (.56)
Fall AUD symptoms	3.56 (2.84)	3.97 (3.35)	-.79 (.43)	-	-	-
Spring AUD symptoms	3.29 (2.85)	4.41 (3.23)	***-2.39 (.02)***	1.11 (1.71)	1.02 (1.50)	.29 (.78)
Family History (*n*, %)						
Mother	4 (4.7)	5 (5.9)	-.36 (.72)	6 (9.4)	1 (1.6)	**1.94 (.05)**
Father	19 (22.1)	19 (22.4)	-.05 (.97)	8 (12.5)	9 (14.1)	-.26 (.79)
Any Parent	20 (23.3)	21 (24.7)	-.22 (.83)	9 (14.1)	9 (14.1)	0.00 (1.0)

Family history. For family history of alcohol problems, 6.5% of intervention participants and 4% of control group participants reported that they believed their mother had a drinking problem at some point in her life. Family history of alcohol problems was more common among fathers, with paternal drinking problems endorsed at a rate of 17.6% in the intervention group and 18.5% in the control group. Overall, 19.0% of intervention participants and 19.9% of control group participants reported any parental history of drinking problems. Although participants were not matched on this factor, there were no significant differences between the intervention and control group on the proportion reporting a parental history of problems with alcohol. Table 4 provides comparisons of family history positive and family history negative individuals across the whole sample. Comparing alcohol consumption and AUD symptoms for family history positive (FH+) and family history negative (FH-) individuals, the FH+ group reported higher on average drinking days, drinks per occasion, and AUD symptoms in both the fall and spring semesters. However, the mean differences between FH+ and FH- groups were only significant for fall AUD symptoms, t (266) = 2.46, p = .002, and spring AUD symptoms, t *(266)* = 2.13, p = .03.

Table 4.

Comparison of Descriptive Data Between Individuals With and Without a Family History of Alcohol Problems

Variable	Family History Positive *n* = 59 (19.4%)	Family History Negative *n* = 209 (68.8%)	*t*/z (*p*)
Age (mean [SD])	18.39 (0.35)	18.42 (0.33)	-.73 (.47)
Sex (*n* [%])			
Female	44 (74.6)	138 (66)	1.24 (.21)
Race/Ethnicity (*n* [%])			
Asian	7 (11.9)	55 (26.3)	**-2.33 (.02)**
Black/African American	14 (23.7)	39 (18.7)	.86 (.39)
Hispanic/Latino	6 (10.2)	9 (4.3)	1.73 (.08)
White	32 (54.2)	106 (50.7)	.48 (.63)
Initated alcohol use (*n* [%])			
Fall drinker	86 (56.2)	85 (56.3)	
Spring drinker	110 (71.9)	118 (78.1)	
Alcohol use (mean [SD])			
Fall drinking days	2.31 (4.06)	1.37 (2.99)	1.65 (.10)
Spring drinking days	2.54 (3.54)	1.81 (2.73)	1.68 (.09)
Fall drinks per occasion	2.13 (2.52)	1.56 (2.47)	1.52 (.13)
Spring drinks per occasion	2.72 (2.64)	2.24 (2.46)	1.26 (.21)
Fall AUD symptoms	3.07 (3.86)	1.69 (2.72)	**2.46 (.002)**
Spring AUD symptoms	3.45 (3.38)	2.49 (2.83)	**2.13 (.03)**

Note. Total N = 268. Age is calculated in years for Freshman year. Drinking days and drinks per occasion were reported on past 30 days use. Alcohol use disorder (AUD) symptoms were reported on lifetime in the Fall and since starting college in the Spring.

Intervention only variables. Descriptive statistics for data collected at the time of the intervention are displayed in Table 5. Upon completing BASICS, intervention participants were asked to report their number of days drinking and typical drinks per occasion over the past 30 days. Based on this report, 95.3% of baseline drinkers and 54% of baseline non-drinkers endorsed any past 30 days alcohol consumption. Participants averaged 2.03 (SD = 2.80) drinking days and 3.25 (SD = 2.23) drinks per occasion at the time of the intervention. These values decreased to an average of 2.19 (SD = 2.40) days drinking, $t(148) = .35$, p = .73, and 1.91 (SD = 2.91), $t\ (113) = 2.50$, $p = .01$, drinks per occasion approximately one month later at the spring follow-up assessment.

Table 5.

Comparison of Intervention Measures Between Baseline Drinkers and Non-drinkers

Variable	Baseline Drinkers *n* = 86	Baseline Non-drinkers *n*=64	Overall Sample *n* = 150	*t*/*z* (*p*)
Drinker at intervention (*n* [%])	82 (95.3)	35 (54.7)	117 (.78)	**5.95 (<.001)**
Alcohol use (mean [SD])				
Intervention drinking days	2.99 (3.03)	0.78 (1.86)	2.03 (2.80)	**5.15 (<.001)**
Spring drinking days	2.91 (3.33)	.62 (1.44)	1.91 (2.91)	**5.15 (<.001)**
Intervention drinks per occasion	3.58 (2.54)	1.12 (2.09)	2.38 (2.49)	**5.23 (<.001)**
Spring drinks per occasion	3.32 (2.48)	.75 (1.22)	2.19 (2.40)	**7.63 (<.001)**
Concern for one's drinking (mean [SD])	1.44 (.75)	1.24 (.61)	1.36 (.70)	1.75 (.08)
0 Not at all concerned (*n* [%])	61 (70.9)	54 (85.7)	116 (76.3)	-1.93 (.05)
1 Slightly concerned (*n* [%])	12 (14.0)	3 (4.8)	15 (10.0)	1.87 (.06)
2 Moderately concerned (*n* [%])	13 (15.1)	6 (9.4)	19 (12.5)	1.05 (.29)
Readiness to reduce peak BAC (mean [SD])	1.81 (1.16)	1.44 (1.52)	1.67 (1.32)	1.69 (.09)
0 Not at all (*n* [%])	13 (15.1)	25 (40.3)	38 (25.3)	**-3.34 (<.001)**
1 – (*n* [%])	22 (25.6)	12 (19.4)	34 (22.2)	.99 (.32)
2 Moderately concerned (*n* [%])	25 (29.1)	9 (14.5)	35 (23.3)	**2.17 (.03)**
3 -- (*n* [%])	20 (23.3)	5 (7.8)	26 (17.3)	**2.51 (.01)**
4 Completely (*n* [%])	6 (7.0)	11 (17.7)	17 (11.3)	-1.95 (.05)

Note. Intervention drinking days and Intervention drinks per occasion were measured at the same time the intervention was administered (January).

The average level of concern for one's own drinking was 1.44 (SD = 0.75) for baseline drinkers and 1.24 (SD = 0.61) for baseline non-drinkers. Average readiness to reduce peak BAC was 1.81 (SD = 1.16) for baseline drinkers and 1.44 (SD = 1.52) for baseline non-drinkers. Overall, the majority of intervention participants (76.3%) were "not at all concerned" about their drinking, whereas the distribution of readiness to reduce peak BAC was more varied. Approximately half of the sample (51.9%) fell into the range of moderately to completely ready to reduce their peak BAC. Concern for one's own drinking and readiness to reduce peak BAC were significantly correlated, r (150) = .29, $p < .001$. Concern for one's own drinking was also correlated with days drinking at the time of the

intervention, r (152) = .17, p = .04, but not drinks per occasion. There was no evidence of any correlations between concern or readiness and post-intervention alcohol consumptions.

Aim 1: The Effect of BASICS on Post-intervention Alcohol Outcomes

In order to thoroughly investigate the effect of BASICS as a universal brief alcohol intervention for college students, we conducted Aim 1 analyses among all participants, as well as separately according to baseline drinking status (non-drinkers, and drinkers). Using hierarchical regression, we tested the effect of treatment (BASICS or Control) on self-reported alcohol use outcomes (drinks per occasion, days drinking, and AUD symptoms) at Time 2 after controlling for race/ethnicity, sex, and Time 1 drinking variables.

Intervention effects among all participants. All variables together (gender, race/ethnicity, Time 1 drinking days, and treatment assignment) significantly predicted spring (Time 2) drinking days, F (6, 284) = 27.38, p < .001, R^2 = .366. Time 1 drinking days were positively associated with Time 2 drinking days (β = .59, t (284) = 11.9, p < .001), whereas reporting race/ethnicity as Asian was associated with fewer drinking days at Time 2 (β = -.10, t (284) = -2.04, p = .04). Treatment assignment (β = -.01, t (284) = -.26, p = .80) did not significantly contribute to the variance in the overall model, $\Delta R^2 < .001$, $\Delta F(1, 284) = .07$, $p = .80$. Similarly, for drinks per occasion, the overall model was significant, F (6, 275) = 43.98, p < .001, R^2 = .49, but treatment assignment, β = -.03, t (275) = -.64, p = .52, was not a significant predictor of Time 2 drinks per occasion. Time 1 drinks per occasion significantly predicted Time 2 drinks per occasion, β = .69, t (275) = 15.5, p < .001); however, reporting Asian race/ethnicity was not associated with drinks per occasion. These results suggest that treatment assignment was not predictive of

spring semester rates of alcohol consumption over and above the effect of baseline alcohol use, race/ethnicity, and gender.

To investigate the effect of completing BASICS on spring semester AUD symptoms after controlling for baseline AUD symptoms and covariates, a hierarchical multiple regression was conducted. Among all participants, the overall model significantly predicted Time 2 AUD symptoms, F (6, 294) = 28.93, p < .001, R^2 = .371, with treatment assignment significantly improving the prediction of Time 2 AUD symptoms, ΔR^2 = .01, ΔF (1, 294) = 3.90, p = .05. A positive association between Time 1 and Time 2 AUD symptoms was observed (β = −.11, t (294) = −.16, p < .001), suggesting that higher levels of fall semester AUD symptoms predicted higher AUD symptoms in the spring semester. In contrast, completing BASICS (β = −.09, t (294) = −1.97, p =.049) and reporting race/ethnicity as Asian (β = −.11, t (294) = −2.16, p =.03) predicted lower Time 2 AUD symptoms.

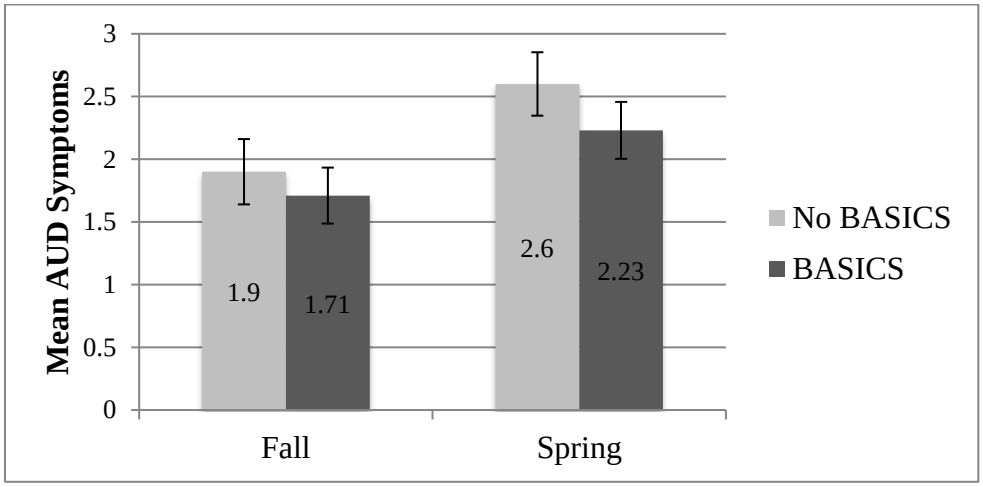

Figure 2. Differences in Alcohol Use Disorder Symptoms between BASICS and Control Participants. Comparison of means scores for fall semester and spring semester (post-intervention) alcohol use disorder symptoms. Results indicate significantly *fewer* spring alcohol use disorder symptoms in participants who completed BASICS. Data includes all participants in the present study.

Intervention effects among baseline drinkers. We conducted the same tests using hierarchical multiple regression among only those who endorsed initiation of alcohol use at baseline. Descriptive statistics for these two groups are displayed in Table 2. Including covariates (gender, race/ethnicity, and respective baseline alcohol use variable), the overall models were predictive of Time 2 days drinking, F (5, 165) = 28.93, p < .001, R^2 = .371, drinks per occasion, F (6, 294) = 28.93, p < .001, R^2 = .371, and AUD symptoms, F (5, 165) = 3.24, p = .008, R^2 = .089. However, treatment assignment was a significant predictor for only Time 2 AUD such that completing BASICS was associated with fewer AUD symptoms in the spring semester (β = -.12, t (158) = -3.00, p =.003). Treatment assignment explained an additional 4.3% of the variance in Time 2 AUD symptoms over and above the effect of baseline AUD symptoms, race/ethnicity, and gender, $\Delta R^2 = .043$, $\Delta F(1, 164) = 8.37$, $p = .003$. Reporting race/ethnicity as Asian was also predictive of lower Time 2 drinking days ($\beta = -.16$, $t(158) = -2.08$, $p = .04$), and AUD symptoms ($\beta = -.18$, $t(158) = -2.26$, $p = .03$).

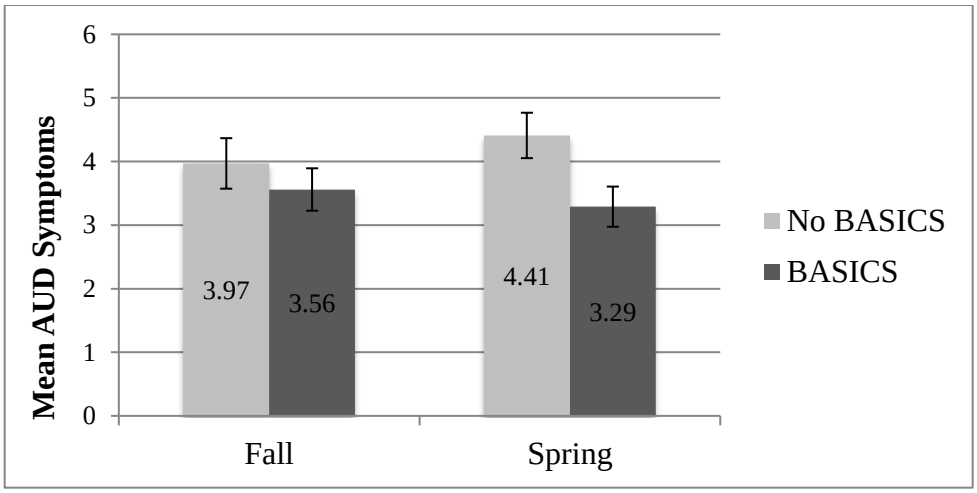

Figure 3. Differences in Alcohol Use Disorder Symptoms between Baseline Drinkers in BASICS and Control Groups. Comparison of means scores for fall semester and spring semester (post intervention) alcohol use disorder symptoms among baseline drinkers. Results indicate significantly *fewer* spring alcohol use disorder symptoms in participants who completed BASICS. Data includes baseline drinkers only.

Intervention effects among baseline non-drinkers. Hierarchical multiple regression was used to test for the effect of BASICS on Time 2 alcohol variables over and above gender and race/ethnicity; however, baseline alcohol variables were constant among this group and accordingly removed from the model. The overall models for all three outcomes (days drinking, drinks per occasion, and AUD symptoms) were not significantly predictive of Time 2 drinking. There was no evidence that, among baseline non-drinkers, treatment assignment was predictive of Time 2 drinking days ($\beta = .07$, $t\ (120) = .76$, $p = .45$), drinks per occasion ($\beta = -.01$, $t\ (120) = -.10$, $p = .92$), or AUD symptoms ($\beta = .01$, $t\ (120) = .11$, $p = .912$). Covariates (gender, race/ethnicity) also showed no evidence for association with Time 2 drinking outcomes among this group.

In addition to exploring main effects of the intervention on alcohol consumption and AUD symptoms, we also used logistic regression to determine if non-drinkers who completed BASICS were less likely to initiate alcohol use in the spring semester than

baseline non-drinkers in the control group. Results of the logistic regression displayed in Table 5 indicate that individuals who completed BASICS were s 91% less likely to have initiated drinking in the spring, $\chi 2$ (5) = 18.86, p = .002. Control variables (gender, race/ethnicity) were included in the model, but there was no evidence of a significant association with spring semester alcohol initiation for these covariates.

Table 5.

Logistic Regression Results

DV: Initiated Alcohol Use in Spring Semester or Not	R^2=.19 (Cox & Snell), .26 (Nagelkerke). Model $\chi^2(5)=18.86$, p = .002. *$p < .05$			
			95% CI for Odds Ratio	
	B(SE)	*Odds Ratio*	*Lower*	*Upper*
Gender	.57(0.55)	1.76	.60	5.18
Asian	.295(.33)	.74	.20	1.77
Hispanic or Latino	.42(1.18)	1.52	.15	15.35
Black or African American	.06(.67)	1.06	.29	3.95
BASICS	-2.35*(.68)	.095	.03	.36

Note. For Gender, 0=female, 1=male. For race, White was used as the reference group. BASICS=Completed the intervention, and 0=no, 1=yes, R^2=.19 (Cox & Snell), .26 (Nagelkerke). Model $\chi^2(5)=18.86$, p = .002. *p < .05.

Aim 2: Moderators of Intervention Effectiveness

Baseline alcohol variables (drinking days, drinks per occasion, and AUD symptoms) and family history of alcohol problems were examined as moderators of the relationship between treatment assignment and Time 2 alcohol outcomes. In order to prepare the variables for analyses, independent and moderator variables were centered and multiplied to create a product term (Baron & Kenney, 1986). Tests of baseline alcohol variables as moderators were conducted with all participants and separately with baseline drinkers alone. Baseline alcohol variables for non-drinkers were constant, and thus could not be examined as moderators in non-drinkers alone.

Time 1 alcohol variables as moderators among all participants. Using hierarchical multiple regression, we examined whether the effect of the intervention varied according to rates of baseline alcohol variables: drinking days, drinks per occasion, and AUD symptoms. Each model controlled for the effect of covariates (gender, race/ethnicity) before testing for an interaction. The relationship between treatment and spring days drinking was moderated

by fall days drinking (β = -.16, *t* (283) = -2.24, *p* = .03). As illustrated in Figure 2, the intervention was associated with lower rates of spring drinking days among those with higher levels of fall drinking days compared to infrequent or non-drinkers in the fall semester. Simple slopes analyses indicated that the range of significance for this moderation effect falls between 2.65 and 16.98 fall drinking days per month.

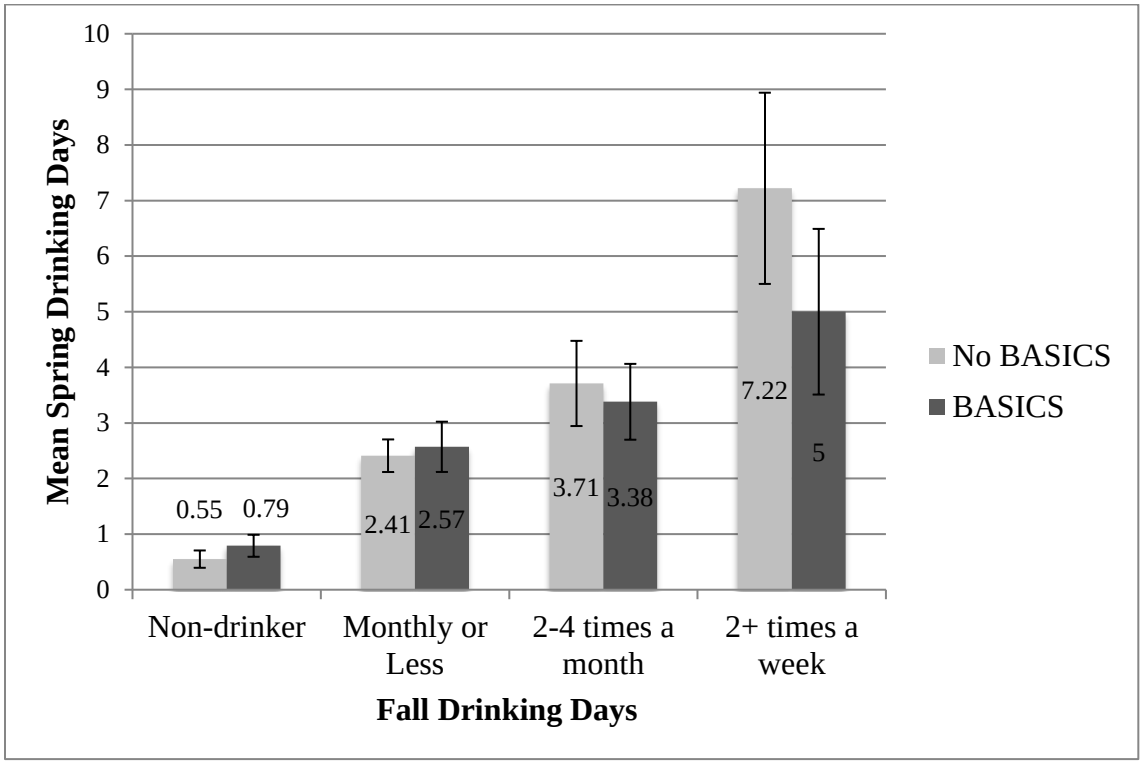

Figure 4. Comparison of Spring Drinking Days According to Baseline Drinking Days Intervention and Control Participants. Intervention participants (BASICS) who reported two or more drinking days per week at baseline showed significantly *fewer* spring drinking days than those who did not complete BASICS (no BASICS). Data includes all participants in the sample.

There was, however, no evidence to suggest that Time 1 drinks per occasion moderated the association between BASICS and Time 2 drinks per occasion. We also found no indication of an interaction between Time 1 AUD symptoms and BASICS on Time 2 AUD symptoms

(β = -.09, *t* (291) = -1.43, *p* = .15), suggesting that the effect of BASICS on spring AUD symptoms does not vary at different levels of baseline AUD symptoms in our sample.

Time 1 alcohol variables as moderators among baseline drinkers. Results of the moderation analyses among Time 1 drinkers alone were similar to those of the tests conducted with all participants for drinks per occasion and AUD symptoms. There was no indication that, among baseline drinkers, the effect of the intervention was moderated by Time 1 drinks per occasion, β = -.02, *t* (157) = -.21, *p* = .83, or Time 1 AUD symptoms, β = -.04, *t* (163) = -.41, *p* = .68. Unlike the analyses with all participants, among baseline drinkers alone, there was no evidence of a main effect of treatment on Time 2 drinking days nor was there support for an interaction between baseline drinking days and BASICS on Time 2 drinking days (β = -.17, *t* (157) = -1.57, *p* = .12).

Family history as a moderator among all participants. Family history of alcohol use problems was tested as a moderator of the relation between BASICS and Time 2 alcohol use outcomes. Descriptive drinking statistics according to family history are displayed in Table 3. Time 1 drinking days was predictive of Time 2 days, β = .59, t (251) = 11.18, *p* < .001; however, no main effects of treatment, β = -.003, *t* (251) = -.05, *p* = .96, or family history, β = -.04, *t* (251) = -.53, *p* = .60, were observed. There was also no evidence of an interaction between BASICS and family history on Time 2 drinking days, β = -.07, t (251) = -.90, *p* = .37. Similarly, for drinks per occasion, Time 1 predicted Time 2, β = -.68, *t* (241) = 14.17, *p* < .001, but there was no indication of main effects of treatment, β = -.004, *t* (241) = -.08, *p* = .94 or family history, β = .06, *t* (241) = .84, *p* = .40, on Time 2 drinks per occasion. We also found no support for an interaction between BASICS and Time 1 drinks per occasion on Time 2 drinks per occasion, β = -.12, *t* (241) = -1.71, *p* = .09.

Testing family history as a moderator of treatment effectiveness on the dependent variable Time 2 AUD symptoms, we found a main effect of Time 1 AUD symptoms, $\beta = .60$, t (211) = 10.92, $p < .001$. Although there was no evidence for main effects of family history or treatment, we did find that family history significantly moderated the relationship between BASICS and Time 2 AUD symptoms, $\beta = -.15$, t (211) = -1.95, $p = .05$. As seen in Figure 5, the direction of this effect was such that among family history positive individuals, those who completed BASICS reported significantly fewer Time 2 AUD symptoms than those who did not complete BASICS.

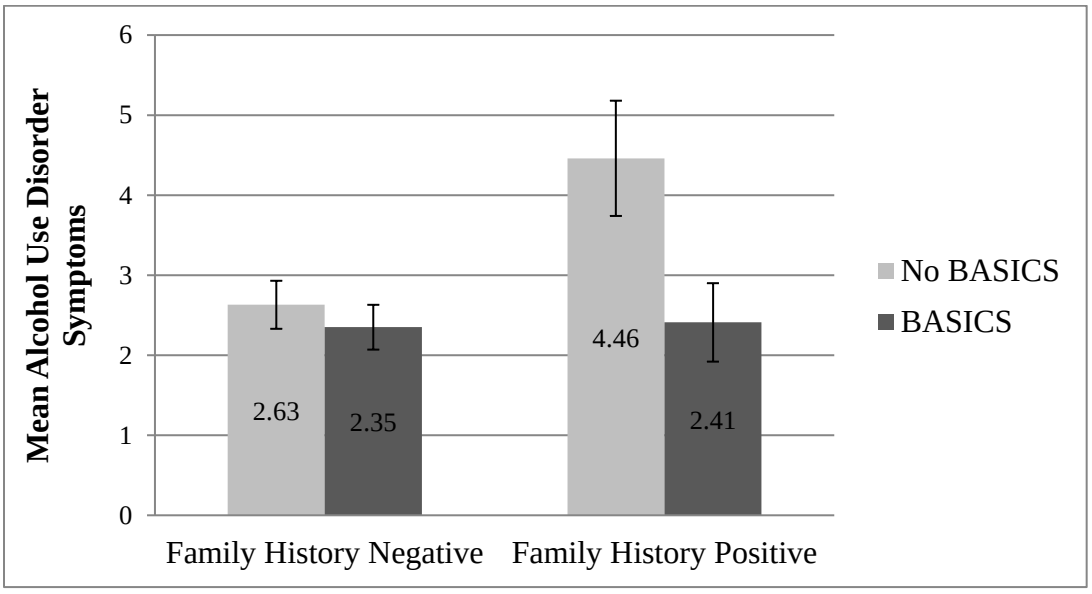

Figure 5. Effects of BASICS and Family History on Spring Alcohol Use Disorder Symptoms Among All Participants. Chart shows a comparison of means between family history positive and family history negative individuals who did and did not complete the BASICS intervention. Family history positive individuals in BASICS reported fewer spring semester (post-intervention) alcohol use disorder symptoms than those who did not complete BASICS. Data includes all participants in the present study.

Family history as a moderator among baseline drinkers. Consistent with the findings for all participants, Time 1 drinking days, $\beta = .38$, t (136) = 4.68, $p < .001$, and reporting race as Asian, $\beta = -.17$, t (136) = -2.08, $p = .04$, were associated with Time 2 drinking days. There was also no evidence for main effects of treatment, family, nor an

interaction between those treatment and family on drinking days. In contrast to the results among all participants, positive family history of alcohol use problems was predictive of higher levels of Time 2 drinks per occasion, $\beta = .19$, t (126) = 2.02, $p = .05$. In addition, family history moderated the association between BASICS and Time 2 drinks per occasion, such that completing BASICS predicted significantly fewer Time 2 drinks per occasion among participants with a positive family history of alcohol use problems, $\beta = -.36$, t (126) = -3.50, $p = .001$. This interaction is displayed in Figure 6.

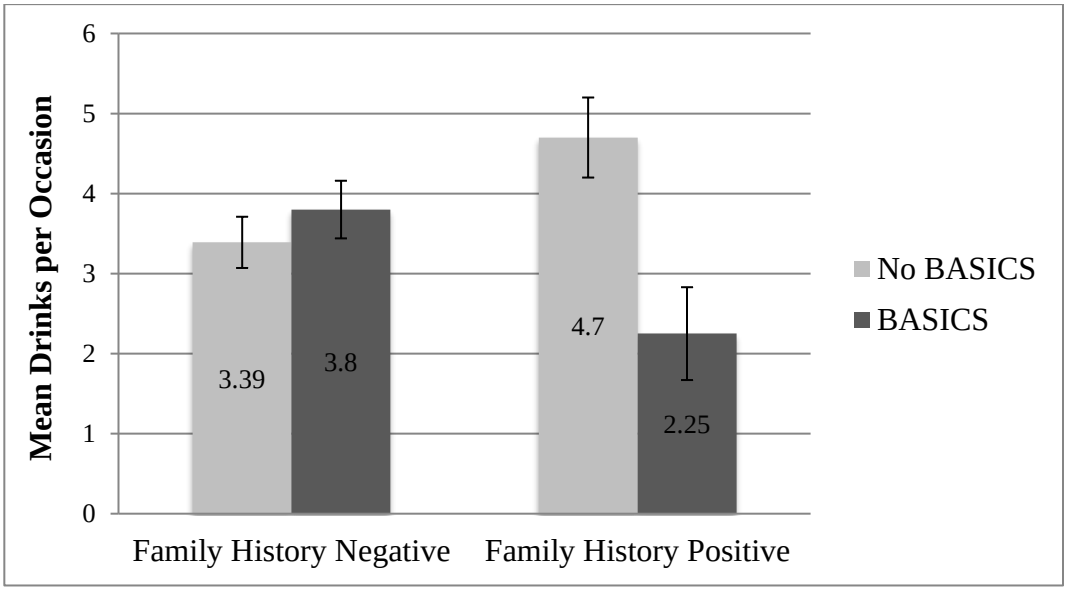

Figure 6. Effects of BASICS and Family History on Spring Drinks Per Occasion Among Baseline Drinkers. Chart displays a comparison of means between family history positive and family history negative individuals who did and did not complete the BASICS intervention. Family history positive individuals in BASICS reported fewer spring semester (post-intervention) drinks per occasion than those who did not complete BASICS. Data includes only baseline drinkers.

For Time 2 AUD symptoms as the dependent variable, the results were consistent with those from the all participant group. Time 1 AUD symptoms were positively associated with Time 2 AUD symptoms, $\beta = .19$, t (110) = 2.02, $p = .05$. The relationship between BASICS and Time 2 AUD was again moderated by family history. As shown in Figure 7, completing BASICS was predictive of fewer Time 2 AUD symptoms among baseline

drinkers with a positive family history of alcohol use problems, β = -.28, *t* (110) = -2.16, *p* = .03.

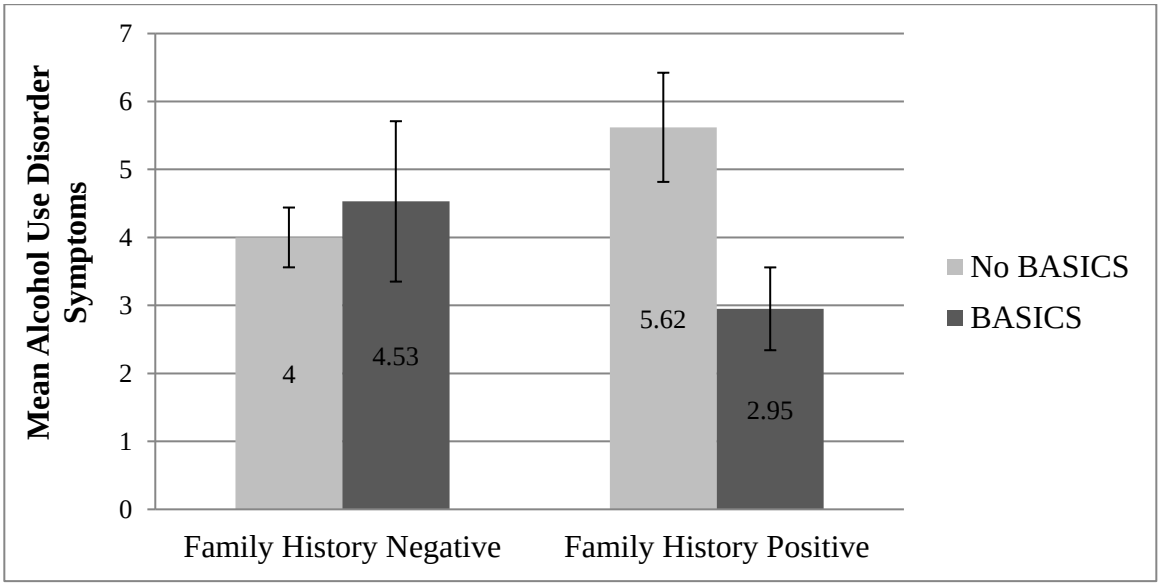

Figure 7. Effects of BASICS and Family History on Spring Alcohol Use Disorder Symptoms Among Baseline Drinkers. Chart shows a comparison of means between baseline drinkers with and without a family history of alcohol problems in BASICS and control (No BASICS) groups. Family history positive individuals in BASICS reported fewer spring semester (post-intervention) alcohol use disorder symptoms than those who did not complete BASICS. Data includes all participants in the present study.

Family history as a moderator among baseline non-drinkers. Among baseline non-drinkers alone, we found no evidence that family history moderates the effect of the intervention on Time 2 days drinking, β = .15, *t* (107) = 1.03, *p* = .30, drinks per occasion, β = .18, *t* (107) = 1.32, *p* = .20, or AUD symptoms, β = -.01, *t* (107) = -.07, *p* = .95. There were also no observed main effects of family history or treatment on the outcomes in this sample of baseline non-drinkers.

Aim 3: Intervention Components as Moderators of Effectiveness

For Aim 3 analyses, we examined the role of specific components of the intervention, namely self-reported concern for one's own drinking and readiness to reduce peak Blood

Alcohol Content (BAC), on intervention effectiveness. Across all intervention participants, alcohol consumption variables measured at the time of the intervention (drinking days and drinks per occasion) were significantly positively associated with their respective Time 2 (post-intervention) rates, with beta values ranging from β = .51 - .71 ($p < .001$) for days drinking and β = .58 - .74 ($p < .001$) for drinks per occasion.

Level of concern among all intervention participants. Using hierarchical multiple regression, we tested for the presence of an effect of level of concern for one's own drinking on Time 2 (post-intervention) drinking days and drinks per occasion after controlling for covariates. We found no support for an association between level of concern and Time 2 drinking days, β = -.02, t (139) = -.36, p = .72, or drinks per occasion, β = .003, t (139) = .03, p = .97. There was also no evidence that level of concern moderated the relation between alcohol consumption reported at the time of the intervention and Time 2 drinking days, β = -.04, t (139) = -.68, p = .50, or drinks per occasion, β = .12, t (139) = 1.43, p = .16.

Level of concern among current drinkers. Similar to the results for level of concern among all participants, there was again no evidence for an association with post-intervention drinks per occasion, β = .003, t (77) = .03, p = .97, or drinking days, β = -.10, t (77) = -1.01, p = .31. There was also no support for interaction effects between drinks per occasion and concern β = .05, t (77) = .53, p = .60, or drinking days and concern, β = -.04, t (77) = -.41, p = .69.

Readiness to reduce peak BAC among all intervention participants. After accounting for current alcohol use, there was no evidence for a main effect of readiness to reduce peak BAC on spring drinking days, β = -.02, t (139) = -.36, p = .72. There was also no support for an interaction between drinking days at the time of the intervention and

readiness to reduce peak BAC, β = -.10, *t* (139) = -1.57, *p* = .12. Similarly, there was no indication that readiness to reduce peak BAC was associated with Time 2 drinks per occasion, β = -.03, *t* (139) = -.33, *p* = .74, nor was there evidence for a moderation effect, β = -.11, *t* (139) = -1.37, *p* = .18.

Readiness to Reduce Peak BAC Among Current Drinkers. We observed no evidence of an effect of readiness to reduce peak BAC on Time 2 drinks per occasion, β = .04, *t* (72) = .44, *p* = .67, or drinking days, β = .04, *t* (77) = .36, *p* = .72. There was also evidence of a moderation effect on drinks per occasion, β = .06, *t* (72) = .67, *p* = .51, or drinking days, β = .03, *t* (77) = .34, *p* = .74.

Across all tests, we found no evidence of a relationship between level of concern for one's own drinking or readiness to peak BAC and post-intervention alcohol consumption.

Discussion

The present study examined the effect of a brief, web-based preventive intervention on alcohol consumption and alcohol use disorder symptoms among a sample of diverse college freshmen. A wide range of drinking patterns were represented in the sample, from non-drinkers to heavy drinkers, so as to better understand the effectiveness of a BASICS employed as a universal program for all college students.

Summary of Findings

The first aim examined the effect of the intervention on alcohol consumption and alcohol use disorder (AUD) symptoms across the whole sample, and then separately among baseline drinkers and nondrinkers. Both intervention and control group participants significantly increased alcohol consumption and AUD symptoms from fall to spring semester, which is consistent with other research that has shown alcohol use increases across

the first year of college (Baer, Kivlahan, Blume, McKnight, & Marlatt, 2001). We found no support for the hypothesis that completion of BASICS was associated with fewer drinking days or drinks per occasion in the spring semester. However, for AUD symptoms, we found that BASICS was associated with lower symptoms in the spring semester in the whole sample, an effect that was driven by baseline drinkers. This finding was not significant for the baseline non-drinking group. There were some benefits to completing the intervention for non-drinkers, though. Our hypothesis that non-drinkers who completed BASICS were less likely to initiate alcohol consumption in the spring was supported.

Variations in baseline alcohol variables were explored as moderators of intervention effectiveness in the second aim of the study. We tested for interaction effects across the whole sample, as well as among baseline drinkers only. Baseline alcohol variables for non-drinkers were constant, and thus we could not test for moderating effects of baseline alcohol variables in this group alone. Among the whole sample, our hypothesis that higher rates of fall drinking would predict greater responsiveness to the intervention was supported for days drinking, but not drinks per occasion. However, when looking at baseline drinkers only, there was no evidence for an interaction between baseline drinking days or drinks per occasion on post-intervention drinking. There was also no evidence to support the hypothesis that higher levels of baseline AUD symptoms were associated with greater response to intervention.

We also tested for interactions between BASICS and family history of alcohol problems on spring drinking days, drinks per occasion, and AUD symptoms. For these analyses, family history was tested as a moderator in the whole sample, as well as baseline drinkers and non-drinkers. In the whole sample, family history significantly moderated the

association between BASICS and spring AUD symptoms. The direction of this effect indicated that individuals with a positive family history who completed BASICS reduced their AUD symptoms compared to controls. Among baseline drinkers, individuals with a family history of alcohol problems appear to have responded better to BASICS as measured by post-intervention AUD symptoms and drinks per occasion. Neither the whole sample nor the baseline drinking group showed support for family history as a moderator of BASICS on spring drinking days. In the baseline non-drinkers, we found no evidence of main effects or interaction effects on any of the three outcomes of interest (drinking days, drinks per occasion, or AUD symptoms).

The third aim of the study examined components of the intervention (readiness to change and level of concern for one's own drinking) as moderators of change in alcohol consumption. We found no evidence to suggest that changes in alcohol use between the intervention and the follow-up survey one month later varied according to readiness to change or level of concern for one's own drinking.

Discussion of Findings

Alcohol use and negative consequences associated with drinking are common among college students (Hingson, Heeren, Winter & Wechsler, 2005). Most college students (78%) have tried alcohol, and many may experience harmful repercussions, such as, academic problems, bodily harm or injury, and unwanted sexual experiences, (Caldeira, et al., 2009; Johnston et al., 2015; Wechsler, et al., 2002). The high prevalence of alcohol use requires a broad, universal approach to alcohol intervention and prevention on college campuses. Selective and indicated prevention programs that target only the most heavily drinking students are not sufficient to address the scope of problematic drinking on college campuses

(Weitzman & Nelson, 2004). Brief, web-based interventions with personalized feedback are supported for use among high-risk and heavy drinking college students, but few studies have assessed the benefit of such programs among non-drinkers and low-level drinkers (LaBrie et al., 2013; Saitz et al., 2007). The primary goal of this study was to assess the utility of one such prevention intervention program (BASICS) at reducing drinking days, drinks per occasion, and AUD symptoms among a more heterogeneous group of college students.

Effectiveness of the intervention. We expected to see significantly fewer drinking days and drinks per occasion in the spring semester among those who completed BASICS, but this was not supported in our findings. Our results on these measures are consistent with Palfai et al.'s (2014) study of a universal alcohol intervention with Personalized Normative Feedback, in which the authors also found no significant differences in alcohol consumption between their intervention and control participants at 5 months post-intervention. We did, however, observe significantly lower AUD symptoms among those who completed the intervention, whereas Palfai et al. found no significant differences for their measure of negative consequences. It may be that AUD symptoms is more sensitive metric than negative consequences exclusively, which the Palfai et al. reported were relatively low on average in their sample.

In addition to our examination of BASICS as a universal intervention program, we also studied the effect of the intervention among baseline drinkers only so as to better align with the target audience for a BASICS program (at-risk drinkers). Other research studies of more heavy drinking samples have shown associations between web-based BASICS and reductions in alcohol frequency (LaBrie et al., 2013) and alcohol quantity (Saitz et al., 2007). However, the inclusion criteria for these studies was limited to high-risk and heavy drinkers,

while our sample included all those who had initiated any alcohol use. Studies of college students with more heterogeneous drinking behaviors have produced mixed results. Bersamin et al. (2007) observed beneficial effects on consumption and negative consequences among regular drinkers, but not those who had not consumed alcohol in the month prior to attending college. Several other studies produced no effects or only improved knowledge, beliefs and intention (Kypri & McAnally, 2005; Meier, 1988; Moore, Soderquist, & Werch, 2005; Reis, Riley, Lokman, & Baer, 2000; Sharmer, 2001). Consistent with these latter studies, we found no effect on consumption among baseline drinkers in our sample. We did, however, observe significantly fewer AUD symptoms post-intervention among drinkers who completed BASICS versus controls. The presence of an effect on AUD symptoms in the absence of differences in consumption may be due in part to the harm-reduction approach of BASICS. Students may be practicing protective strategies learned through BASICS that reduce the likelihood of negative consequences without reducing their level of consumption (e.g., alternating with alcoholic beverages with water, eating before drinking, and planning safe transport home).

Among baseline non-drinkers, we found no effect of BASICS on post-intervention alcohol outcomes (drinks per occasion, drinking days, and AUD symptoms). We also employed logistic regression to test for prevention of initiation in non-drinkers, which was modeled after Palfai et al.'s study. They found that non-drinkers who completed their Personalized Normative Feedback intervention were less likely to have initiated alcohol use five months later. We observed the same result approximately one-month post-intervention in our sample, which provides further support for BASICS as a tool to prevent initiation among non-drinking students. It is also important to recall that the messaging for BASICS is

designed to resonate with heavier drinking students. Therefore, brief interventions with content tailored to better reflect the perspectives of non-drinking students may provide additional benefits beyond the preventive effects found in our study, such as reducing consumption among those who do choose to initiate drinking.

Moderators of intervention effectiveness. Our results provide some support for the hypothesis that baseline drinking characteristics play a role in the effectiveness of the intervention. In the whole sample, we found that the relationship between BASICS and post-intervention drinking days differed as a function of their respective baseline rates. Higher rates of baseline drinking days were associated with greater post-intervention differences between intervention and control participants. These findings fit with existing literature that has shown alcohol interventions in college students can interrupt the expected drinking trajectory such that the degree of increase in alcohol use is much less than would be expected (Larimer et al., 2007).

We found support for family history as a moderator of the intervention's effect on spring AUD symptoms among baseline drinker and the whole sample. We also observed an interaction between family history and BASICS on drinks per occasion among baseline drinkers. It is hypothesized that family history of alcohol problems may prime an individual for an intervention by virtue of observing firsthand the degree of harm that can result from risky alcohol use. Although there has been little research on the role of family history in college student interventions, our results are consistent with one study that found reductions in alcohol consumption were amplified among family history positive individuals who completed a female-specific motivational enhancement program (LaBrie, Feres, Kenney, & Lac, 2009; LaBrie et al., 2008). Results from a randomized clinical trial of a brief, web-based

intervention for marijuana use among college students also support greater reductions in marijuana use for individuals with a family history of a drug problem (Lee, Neighbors, Kilmer, & Larimer, 2010). Our findings, in conjunction with this existing literature, suggest that more research on the association between family history and intervention response is warranted.

The overall pattern of our moderation analyses suggests that BASICS was more effective for those with an elevated risk profile: higher baseline alcohol use, greater baseline AUD symptoms, and a family history of alcohol problems. This pattern indicates that BASICS operated as designed, as a selective program for individuals who are at increased risk for problems or have already experienced problems. However, the interaction effect for drinking days was supported for individuals who endorsed approximately 3 or more drinking days per month, which indicates that BASICS had a positive effect on post-intervention drinking days for individuals who were drinking with regularity in the fall semester, not just heavy drinking students. In addition, BASICS was protective against initiation of alcohol use for individuals who were non-drinkers when they completed the intervention. Considered together, these findings support further research in more varied drinking samples, so as to more comprehensively identify the range of students who might benefit from a BASICS-style intervention.

Intervention components. We were unable to discern any effects of readiness to change or level of concern for one's own drinking on change in alcohol use among intervention participants. Although prior research has established that readiness to change is often an important predictor of the degree of behavior change, it is possible that the motivational components of this particular web-based BASICS were not adequate to incite

change (Capone & Wood, 2009; Chiauzzi, Green, Lord, Thum, & Goldstein, 2005). However, the sample for these analyses was limited to the intervention participants only, which may have been too small to detect an effect. There may also be differences in readiness to change for students mandated to an alcohol intervention in response to an alcohol-related infraction compared to the non-sanctioned students in our sample. Other potential mechanisms of change, such as the degree of learning in the social norms re-education component, may have contributed to the outcomes, though this factor was not measured in our study. Participants who responded well to the intervention may have done so as a function of correcting misperceptions about normative drinking in their peers, rather than readiness to change or level of concern.

Study Strengths, Limitations, and Future Directions

Strengths. There are a number of strengths of this study that are important to note. The sample was relatively large and diverse in terms of both demographics and alcohol characteristics. The inclusion criteria did not limit participation to heavy drinkers, which allowed for a more normative range of drinking experiences to be represented. This contributed to the need to identify alcohol prevention intervention programs suitable for all levels of college student drinking experiences, from non-drinkers to heavy drinkers. Our study carried out a relatively novel adaptation of BASICS, an evidence-based prevention intervention program for which there is strong support in high-risk college drinkers, but less research among low-risk students. The study took advantage of existing resources at the university, in that the web-based BASICS program was already available for use by the students. Further, the ongoing longitudinal nature of the Spit for Science project will provide

this study with annual follow-up of alcohol use outcomes while minimizing participant burden.

Limitations. In addition to the strengths described, the results of our study are best understood in the context of several limitations. First, each alcohol use outcome was examined separately in independent models, but existing research has shown that these factors are correlated. Second, only the intervention group was assessed on alcohol use variables at the time of the intervention, so the baseline alcohol use variables used in analyses comparing intervention to control participants were measured several months prior to the intervention. Third, the time frame for the AUD symptoms items in the spring semester encompassed both pre and post-intervention periods (see Figure 1). Although we still found several effects of the intervention on AUD symptoms, the strength of these effects may have been dampened by this overlapping time frame. Fourth, we were unable to identify any components of the intervention that strengthened or weakened its effects. Thus, although we saw some beneficial outcomes, it is difficult to interpret why or how those changes came to fruition. Fifth, moderation analyses require large samples, and our study may have been underpowered to detect some of the hypothesized interaction effects, particularly in the intervention sample alone. By traditional guidelines (Cohen, 1988), all tests were adequately powered to discern a medium effect, and the full sample moderation analyses could detect a small effect. However, authors of a meta-analytic review of moderation found that the average effect size observed in moderation analyses is very small, and suggested that researchers reduce the anticipated interaction effect size in power analyses to reflect these findings (Aguinis, Beaty, Boik, & Pierce, 2005). Lastly, the study relied on self-report data, and although every effort was made to ensure to that participants understood the data they

provided was confidential, there may have been concerns about reporting underage drinking. Self-report data is also vulnerable to measurement error, as it relies on the participant's ability to accurately recall the information in question.

Future directions. This study contributes to our understanding of the utility of a brief, web-based universal approach to alcohol prevention and intervention for college students. Our results encourage further research on expanding the pool of individuals who may benefit from a web-based BASICS program to include non-drinkers, low-risk drinkers, and individuals with a family history of alcohol problems. In addition, evaluating the effects on alcohol use across the college years using Spit for Science longitudinal follow-up surveys may contribute to our understanding of the inconsistent effects seen in long-term outcomes (Carey, Scott-Sheldon, Elliot, Bolles, & Carey, 2009*).* Future analyses should also consider examining other measures of alcohol use, such as maximum drinks in 24 hours and rates of binge drinking, which have shown beneficial reductions in other studies of web-based BASICS programs (LaBrie et al., 2013). Lastly, our study provides further support for additional research on interventions tailored to individual characteristics beyond alcohol use behaviors, such as family history, personality traits, drinking motives, and biological response to alcohol. Customized interventions that better address the wide variety of individual risk profiles show promising preliminary support (Canale, Vieno, Santinello, Chieco, & Andriolo, 2015; Conrod, Castellanos-Ryan, & Mackie, 2011; Savage et al., 2015; Schuckit et al., 2012; Schuckit et al. 2015). However, more research is needed to establish more robust evidence and provide feasible options for universal interventions.

Conclusion

The findings from this study suggest that our universal application of a web-based BASICS intervention produced differential effects across our sample. For drinkers, we found that completing the intervention was associated with significantly fewer spring AUD symptoms. We also observed an interaction between baseline drinking days and BASICS. Intervention participants who were drinking regularly at baseline (approximately three or more days per month) reported significantly fewer spring drinking days than control participants. Family history of alcohol problems appears to play an important role in response to the intervention as well. Individuals with a positive family history who completed the intervention reduced their drinks per occasion and AUD symptoms more than those who did not complete the intervention. Among non-drinkers, completing BASICS greatly reduced the likelihood of initiating alcohol use in the spring semester. However, additional tailoring is necessary to better address the experiences of baseline non-drinking students who do initiate during the first semester of college, as the intervention was not associated with a reduction in alcohol consumption/problems in this group. More research on specific components of interventions that facilitate change in behavior may be helpful for untangling the question of what works best for each individual risk profile.

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