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Efficacy of Alcohol Interventions for First-Year College Students: A Meta-Analytic Review of Randomized Controlled Trials

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Abstract

Objective—Alcohol use established during the first-year of college can result in adverse consequences during the college years and beyond. This meta-analysis evaluates the efficacy of interventions to prevent alcohol misuse by first-year college students.

Methods—Prevention studies were included if the study reported an individual- or group-level intervention using a randomized controlled trial, targeted first-year college students, and assessed alcohol use. Forty-one studies with 62 separate interventions (N = 24,294; 57% women; 77% White) were included. Independent raters coded sample, design, methodological features, and intervention content. Weighted mean effect sizes, using fixed- and random-effects models, were calculated. Potential moderators, determined *a priori*, were examined to explain variability in effect sizes.

Results—Relative to controls, students receiving an intervention reported lower quantity and frequency of drinking and fewer problems (d_+s = 0.07 – 0.14). These results were more pronounced when the interventions were compared to an assessment-only control group (d_+s =

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0.11 – 0.19). Intervention content (e.g., personalized feedback) moderated the efficacy of the intervention.

Conclusions—Behavioral interventions for first-year college students reduce alcohol consumption and alcohol-related problems. Interventions that include personalized feedback, moderation strategies, expectancy challenge, identification of risky situations, and goal setting optimize efficacy. Strategies to prevent alcohol misuse among first-year students are recommended.

Keywords

alcohol; drinking; intervention; first-year students; meta-analysis

The transition from high school to college coincides with a distinct developmental period (i.e., emerging adulthood, ages 18 to 25) characterized by increased identity exploration and rapid behavioral change (Arnett, 2000). Research shows that alcohol consumption peaks during this transition (Fromme, Corbin, & Kruse, 2008). A study with a national sample of nearly 77,000 first-year U.S. college students showed that risky drinking increased within the first few weeks of college while protective behavioral strategies (i.e., active strategies to reduce alcohol consumption such as alternating alcohol with water (Martens et al., 2005); gradually decreased over the same time period (Nguyen, Walters, Wyatt, & DeJong, 2011). During the first few weeks of college, students meet new people, join new social groups, and attend social events where alcohol may be readily available. Through these experiences, perceived norms about college alcohol consumption are formed. Perceptions of typical college student drinking (descriptive norms) as well as perceived peer approval (injunctive norms) during the transition to college predict alcohol consumption during that first year (Neighbors et al., 2008; Pedersen, Neighbors, & LaBrie, 2010; Stappenbeck, Quinn, Wetherill, & Fromme, 2010).

Patterns of high-risk alcohol use established during the first-year of college can result in adverse consequences including academic problems, unprotected sexual behavior, alcohol abuse, and injury or death (Hingson, Heeren, Zakocs, Kopstein, & Wechsler, 2002; Hingson, Zha, & Weitzman, 2009; Wechsler et al., 2002). For some emerging adults, these patterns of risky drinking continue into adulthood (Borsari, Murphy, & Barnett, 2007), increasing the likelihood of experiencing negative consequences related to alcohol consumption. Targeting interventions to incoming college students can minimize the untoward consequences of their alcohol use.

We conducted a meta-analysis to summarize the scientific evidence regarding the efficacy of alcohol interventions targeting first-year students and to identify intervention components that increase the efficacy of these programs. Efficacy was measured using two categories of outcomes (a) alcohol consumption (quantity consumed, quantity consumed during specific intervals, frequency of drinking days, frequency of heavy drinking) and (b) alcohol-related problems. Because the type of comparison condition (e.g., assessment only vs. active comparisons) is related to the magnitude of intervention effects (Grissom, 1996), we examined intervention efficacy relative to type of control. We hypothesized that first-year college students who received any alcohol intervention would report lower alcohol

consumption and fewer alcohol-related problems compared to controls and that these results would be more pronounced when the interventions were compared to assessment-only (no treatment) vs. active controls.

Moving beyond efficacy to effectiveness of alcohol-related interventions for first-year students requires an understanding of *for whom* and the *conditions* in which changes in alcohol consumption and alcohol-related problems occur (La Greca, Silverman, & Lochman, 2009). Therefore, we examined the extent to which the efficacy of the interventions depended upon sample or intervention characteristics. Hypothesized moderators included (1) demographic variables (e.g., sex, ethnicity), (2) prior alcohol use, and (3) intervention components (e.g., personalized feedback, moderation strategies, goal-setting) and delivery format (i.e., individual vs. group; face-to-face vs. computer-delivered interventions). We hypothesized that interventions would be more effective when they (1) sampled greater proportions of students that use alcohol more frequently and consume larger quantities of alcohol (i.e., men and Caucasians) (Johnson, O'Malley, Bachman, & Schulenberg, 2011; O'Malley & Johnston, 2002); (2) sampled greater proportion of students who had prior experience consuming alcohol because prior alcohol use predicts future alcohol use (Ouellette & Wood, 1998); and (3) used intervention components (i.e., personalized feedback, normative comparisons) (Borsari et al., 2007; Larimer & Cronce, 2007) and delivery formats (i.e., individual and face-to-face interventions) (Carey, Scott-Sheldon, Carey, & DeMartini, 2007) shown to be effective at reducing alcohol consumption and alcohol-related problems.

Method

Sample of Studies and Selection Criteria

Studies were retrieved from (1) electronic databases, (2) reference sections of relevant papers, (3) professional journals, and (4) author responses to requests. First, we searched several electronic databases (PubMed, PsycInfo, ERIC, CINAHL, Dissertation Abstracts, NIH RePORTER, and The Cochrane Library) using a Boolean search strategy that included the following terms: (alcohol OR drink* OR binge) AND (college OR university) AND (intervention OR prevention). The search terms were modified using individual database search guidelines, as needed, for each electronic database searched. The searches were restricted to studies that sampled adolescents or young adult populations (e.g., young adulthood [18–29 yrs] in PsycInfo). We conducted a broad search of the alcohol literature rather than restricting the search to first-year students only. The broad database searches were conducted twice with the final broad search completed in May, 2010. A focused database search, using the same terms described above but restricting the search to first-year students only, was conducted in April 2013. Second, we reviewed the references of relevant papers and narrative reviews obtained through the database searches. Third, we examined the tables of contents and/or abstracts available from relevant electronic journals. Finally, we sent messages to several electronic mailing lists requesting relevant papers.

Studies fulfilling the selection criteria and available by April 2013 were included. To be included, studies had to (1) examine an individual- or group-level intervention to reduce alcohol use, (2) sample first-year college students, (3) use a randomized controlled trial

(RCT) with a comparison group, (4) measure alcohol use, and (5) provide sufficient statistical information to calculate effect sizes (ES). Studies were excluded if they (1) did not focus on alcohol use (e.g., combined substance use interventions), (2) sampled other college students (i.e., upperclass students), or (3) included a mass media or structural-level (e.g., campus alcohol policies, campus-wide social norms interventions) intervention component. Forty-one studies (62 interventions) were included in the meta-analysis (Figure 1).

Coding and Reliability

Two coders (trained post-Bachelor and post-Master's level research assistants) independently rated the study information, sample characteristics (e.g., sex), design and measurement specifics (e.g., number of follow-ups), and length and content of intervention (e.g., number of total minutes) for the complete set of 41 papers (and 13 supplemental papers) included in the meta-analysis. Study quality was assessed using 14 items (e.g., random assignment, retention) adapted from validated measures (Jadad et al., 1996; W. R. Miller et al., 1995); scores range from 0 to 20. A random selection of 20 studies was used to calculate inter-rater reliability. For the categorical variables, raters agreed on 84% of the judgments (mean Cohen's kappa = 0.65, signifying substantial agreement) (Landis & Koch, 1977). Reliability for the continuous variables (calculated using the intraclass correlation coefficient; ρ) yielded an average ρ of 0.82 (median = 0.97). The content coding of each study was compared, and discrepancies between coders were resolved through discussion.

Study Outcomes

ES estimates were calculated for alcohol consumption and alcohol-related problems. *Alcohol consumption* outcomes included: (1) quantity consumed over a period of time (e.g., week, month) and (2) during specific intervals (e.g., drinking days, weekends); (3) frequency of drinking days; and (4) frequency of heavy drinking, usually defined as 5 or more drinks for men and 4 or more drinks for women (Wechsler, Dowdall, Davenport, & Rimm, 1995). *Alcohol-related problems* were typically assessed using multi-item scales. From the 41 studies that met the selection criteria, 62 interventions were analyzed. Of these 62, all measured alcohol consumption (42 quantity per week/month, 20 quantity at specific intervals/drinking days, 15 frequency of drinking days, 28 frequency of heavy episodic drinking) and 34 reported alcohol-related problems. If a study reported more than one follow-up (only 27% of the studies), the last delayed follow-up was used in analyses.

Effect Size Derivation

Two study authors [LAJSS, JCE] independently calculated ESs; all ESs were examined for consistency and discrepancies were corrected. ESs were calculated as the mean difference between the treatment and control groups divided by the pooled standard deviation (Cohen, 1988). If means and standard deviations were not provided, other statistical information (e.g., *F*-test, proportion, frequencies) was used to estimate the ES using standard procedures (Lipsey & Wilson, 2001; Sanchez-Meca, Marin-Martinez, & Chacon-Moscoso, 2003). Multiple ESs were calculated from individual studies when they reported more than one outcome variable, multiple intervention conditions, or when outcomes were separated by sample characteristics (e.g., sex of participant). ESs for each intervention and by sample

characteristic were analyzed separately (Lipsey & Wilson, 2001). We adjusted for baseline differences when pre-intervention measures were available (Morris & DeShon, 2002). All of the ESs were corrected for sample size bias (Hedges, 1981). Positive ESs indicates that participants receiving an intervention lowered their alcohol consumption and reported fewer alcohol-related problems relative to controls.

Statistical Analyses

Weighted mean ESs, d_+, were calculated using both fixed- and random-effects procedures (Lipsey & Wilson, 2001). The 95% confidence intervals (CIs) surrounding a weighted mean ES were calculated; CIs indicate the degree of precision as well as the significance of the mean ES (Lipsey & Wilson, 2001). If the CIs surrounding the weighted mean ES does not include a zero, there is a significant difference between means. The homogeneity statistic, Q, was calculated; a significant Q indicates a lack of homogeneity and an inference of heterogeneity. To assess the extent to which outcomes were consistent across studies (heterogeneous), the I^2 index and its corresponding 95% CIs were calculated (Higgins & Thompson, 2002; Huedo-Medina, Sanchez-Meca, Marin-Martinez, & Botella, 2006). I^2 varies between 0% and 100% (Higgins, Thompson, Deeks, & Altman, 2003). If the CIs around I^2 include a zero, the hypothesis of homogeneity is confirmed but if the CIs around I^2 does not include a zero, heterogeneity exists (Huedo-Medina et al., 2006). Differences in ESs, when interventions were compared to assessment only versus an active control condition, were examined using the between-groups-of-studies measure, Q_B, which is the weighed sum of squares of group mean ES about the grand mean ES (Hedges & Olkin, 1985). A fixed-effects model approach was used to examine differences in type of control condition (Lipsey & Wilson, 2001). Asymmetries in the distributions of ESs, indicating a possible reporting bias (Rosenthal, 1979), were examined by inspecting funnel plots (Sterne & Egger, 2001), assessing the degree of funnel plot asymmetry using Begg's (Begg & Mazumdar, 1994) and Egger's (Egger, Davey Smith, Schneider, & Minder, 1997) techniques, and determining the number of studies that could be missing using trim and fill procedures (Duval & Tweedie, 2000).

To explain variability in ESs, the association between sample or intervention characteristics and the magnitude of the effects were examined using a modified weighted regression analysis with weights equivalent to the inverse of the variance for each ES (Hedges, 1994; Lipsey & Wilson, 2001). Both fixed- and mixed-effects regression models were tested. A mixed-effects model is more conservative than a purely fixed-effects model, minimizing the chances of Type I errors, but increase the chances of Type II errors (Lipsey & Wilson, 2001; Overton, 1998). To identifying moderator effects, Lipsey and Wilson (2001) recommend conducting sensitivity tests comparing the results from fixed- and mixed-effects models. Therefore, our moderator tests were initially conducted following fixed-effects assumptions. These tests were followed by moderator tests under mixed-effects assumptions. For these mixed-effect regression models, the inverse variance for each ES included error associated with (a) within-study level sampling error and (b) additional between-study population variance.

Regression analyses examined *a priori* determined moderators. Sample characteristics (4; e.g., proportion women), intervention delivery (2; e.g., individual vs. group), and content (9; e.g., personalized feedback, normative comparisons) were examined as potential moderators of the interventions. Significant moderators were simultaneously entered into multiple regression models to evaluate whether they explained unique variance. All analyses were conducted in Stata 11 (StataCorp, 2009) using published macros (Lipsey & Wilson, 2001; D. B. Wilson, 2001).

RESULTS

Study, Sample, and Intervention Characteristics

Study, sample, and intervention characteristics of the 41 included studies are provided in Table 1. The median publication date is 2008. Methodological quality of the studies ranged from 6 to 16 (out of 20) with an average score of 12 (*SD* = 2.48). (Total methodological quality score was not correlated with any alcohol outcome, *p*s >.06.) Studies were typically conducted at large public universities in the United States. Most students volunteered (49%) or were recruited (46%) to participate in the study. Of the 24,294 first-year college students who consented to participate in the studies, more than half were women (57%), most were White (77%), and averaged 19 years of age. Most participants (*M* = 85%) reported ever consuming alcohol.

Interventions were typically delivered during a single-session lasting less than one hour (*Mdn* = 43 minutes). Most interventions were delivered to individuals (61%) but some were delivered in groups (31%) and others used a combination of individual and group sessions (8%). More than half (52%) of the interventions used a commercially available program (computer program or published manual). Intervention content included alcohol education (77%); normative comparisons (84%); personalized feedback on alcohol consumption, alcohol-related problems, or alcohol-related risks (73%); strategies to modify alcohol consumption (63%); and challenges to expectancies and/or motivations for drinking (47%). Comparison conditions included assessment-only controls (58%) as well as active interventions (42%). The latter were typically delivered in a single session averaging 38 minutes in length. These active controls were brief or time-matched alternative alcohol-related interventions (34%), time-matched general health interventions (5%), or interventions that provided only alcohol education (3%). The last follow-up assessment typically occurred 13 weeks (*Mdn*) after the intervention, but ranged from less than 1 week (0.14 weeks) post-intervention to 208 weeks. (Descriptive details of the study sample and interventions are available in Supplemental Digital Content, Table 1).

Efficacy of Alcohol Interventions Compared with Controls

Weighted mean ESs and homogeneity analyses are presented in Table 2. Overall, first-year students participating in an alcohol intervention reduced their quantity of drinking ($d_{+random}$ = 0.13, 95% CI = 0.07, 0.19), quantity of drinking during specific intervals such as during the weekend or on a specific night ($d_{+random}$ = 0.14, 95% CI = 0.07, 0.21), and frequency of drinking days ($d_{+random}$ = 0.07, 95% CI = 0.02, 0.13) compared to controls. There were no differences between the intervention and control participants on frequency of heavy drinking

($d_{+random}$ = 0.07, 95% CI = −0.01, 0.14) or alcohol-related problems ($d_{+random}$ = 0.06, 95% CI = −0.03, 0.15). (Number of post-intervention assessment weeks was not associated with alcohol-related outcomes, *p*s >.30, except for the frequency of heavy drinking, β = 0.31, *p* =. 02. Frequency of heavy drinking was significantly lower at longer rather than shorter assessment intervals.) Because the hypothesis of homogeneity was rejected for all outcomes except for the quantity of drinking during specific intervals and frequency of drinking days, moderator tests examined whether sample or intervention characteristics determined *a priori* related to the variability in ESs (reported below).

Publication bias—Overall, graphical and statistical tests for publication bias revealed no asymmetries that might be interpreted as publication bias (funnel plots and results of the statistical tests are available in the Supplemental Digital Content): results from Begg's test (Begg & Mazumdar, 1994) were non-significant for all outcomes except for the quantity of alcohol consumed (during specific intervals or drinking days) and the frequency of heavy drinking (*p*s = .02 and .03, respectively) and results from Egger's regression asymmetry test (Egger et al., 1997) were non-significant for all outcomes (*p*s ≥.22) except for the quantity of alcohol consumed (during specific intervals or drinking days) ($p < .001$). Trim and fill procedures (Borenstein, 2005; Duval & Tweedie, 2000) were used to estimate and correct for the possibility of missing studies (based on a rank-based data augmentation procedure). These analyses estimated that 8 studies measuring the quantity of alcohol consumed (during specific intervals or drinking days) and 6 studies measuring the frequency of heavy drinking could be missing. If the presumed missing studies were included in the meta-analysis, the overall weighted mean effect sizes would be similar to the original estimates (quantity: $d_{+random}$ = 0.15, 95% CI = 0.08, 0.21 vs. imputed $d_{+random}$ = 0.09, 95% CI = 0.02, 0.17; frequency: $d_{+random}$ = 0.07, 95% CI = −0.01, 0.15 vs. imputed $d_{+random}$ = 0.02, 95% CI = −0.06, 0.11) suggesting that adding the additional studies would not change our conclusions (i.e., intervention participants reduced their quantity of drinking during specific intervals/ drinking days compared with controls and no impact of the intervention on the frequency of heavy drinking). Results from the tests of funnel plot asymmetry and trim-and-fill procedures support the validity of our conclusions regarding the efficacy of alcohol interventions for first-year students.

Results Stratified by Type of Control Condition

We distinguished between effects of alcohol interventions relative to an active comparisons or assessment only (see Table 3). In these analyses, interventions are stratified by control type (active comparison vs. assessment-only). When compared to an active comparison condition, alcohol interventions for first-year students produced no differential changes in alcohol consumption or alcohol-related problems. In contrast, compared to participants in assessment-only conditions, first-year students who received an alcohol intervention reduced their quantity of drinking, quantity of drinking during specific intervals, frequency of drinking days, frequency of heavy drinking, and reported fewer alcohol-related problems.

To evaluate the significance of the differences between active comparisons conditions and assessment only, we calculated the between-groups-of-studies measure, Q_B,, using a mixed-model approach. We found that intervention participants showed significantly greater

reductions in quantity of drinking (Q_B, [1] = 8.55, p <.01), quantity of drinking during specific intervals (Q_B, [1] = 3.04, p =.08), frequency of heavy drinking (Q_B, [1] = 7.18, p <.01), and alcohol-related problems (Q_B, [1] = 5.79, p =.02) when compared to assessment only controls than when compared to active comparison conditions. There were no significant between-group differences on the frequency of drinking days (Q_B, [1] = 1.91, p =.17).

Moderators of Intervention Impact on Alcohol Consumption and Problems

Bivariate analyses, using both fixed- and mixed-effects models, were conducted to examine *a priori* determined moderators of alcohol consumption and alcohol-related problems. Sample (sex, ethnicity, prior alcohol use) and intervention (delivery mode: individual vs. group, face-to-face vs. computer-delivered; components: alcohol education, normative comparisons, personalized feedback, moderation strategies, challenges to alcohol-related expectancies, goal-setting, identification of high-risk settings, skills-training, and decisional-balance exercises) features were examined. To control for Type I error (fixed-effects models), we used the Bonferroni correction to adjust the p-values, in this case p = .003. We also conducted exploratory analyses to examine whether the total number of intervention components (restricted to the components that were significant moderators of any outcome) or specific components improved the outcomes. Results from the bivariate regression analyses are presented in Table 4, and organized below by outcome.

Quantity of alcohol—Interventions were more successful in reducing the quantity of alcohol consumed by first-year students if the intervention provided personalized feedback (β = 0.56, p <.001), increased students' awareness of high-risk drinking situations (β = 0.36, p = .003), and encouraged students to set goals (β = 0.44, p <.001). All other tests for moderators (fixed-effects models) were non-significant (ps >.003; Bonferroni adjusted p-value). The weighted regression analyses were re-analyzed using mixed-effects assumptions; only personalized feedback remained a significant moderator (β = 0.47, p =.02). When personalized feedback, identification of high-risk drinking situations, and goal-setting were simultaneously entered into a regression model (fixed-effects assumptions), only personalized feedback remained significant (β = 0.51, p =.003); the model was significant, $Q_{Regression}$ (3) = 22.69, p <.001, and accounted for 33% of the variance in quantity consumed.

Quantity of alcohol consumed at specific intervals—No significant moderators were found in analyses using fixed- or mixed-effects assumptions.

Frequency of drinking days—No significant moderators were found in analyses using fixed- or mixed-effects assumptions.

Frequency of heavy drinking—Interventions were more successful at reducing first-year college students' frequency of heavy drinking if they sampled fewer Black-Americans (β = −0.45, p =.002), delivered the intervention to individuals (vs. groups; β = 0.40, p =.002), provided personalized feedback (β = 0.57, p <.001), included moderation strategies (β = 0.57, p <.001), challenged participants' alcohol expectancies (β = 0.52, p <.001), or

encouraged goal-setting (β = 0.54, p <.001). All other tests for moderators (fixed-effects models) were non-significant (ps >.003; Bonferroni adjusted p-value). Personalized feedback, moderation strategies, challenges to alcohol expectancies, and goal-setting remained significant when analyses were conducted using mixed-effects assumptions, ps ≤ .006. When significant moderators were simultaneously entered into a regression model (fixed-effects assumption), only personalized feedback remained a significant predictor of the frequency of heavy drinking (β = 0.56, p =.006).[1] This model was significant ($Q_{Regression}$ [5] = 27.88, p <.001) and accounted for 61% of the variance in the ESs.

Alcohol-related problems—Interventions that provided personalized feedback (β = 0.24, p =.002) and challenged participants' alcohol-related expectancies (β = 0.46, p <.001) were more successful and those that provided skills training (β = −0.36, p <.001) were less successful at reducing alcohol-related problems. All other tests for moderators (fixed-effects models) were non-significant (ps >.003; Bonferroni adjusted p-value). No significant moderators were found using mixed-effects assumptions. Only challenges to alcohol-related expectancies and skills training remained significant moderators of alcohol-related problems when all three variables were simultaneously entered into a regression model using fixed-effects assumptions (ps <.001; personalized feedback did not reach significance, β = 0.15, p =.07). The model was significant ($Q_{Regression}$ [3] = 53.42, p <.001) and accounted for 34% of the variance in the ESs.

Exploratory analyses to identify important intervention components—We also examined how intervention components found to be significant moderators in the meta-regression analyses (i.e., personalized feedback, moderation strategies, challenges to alcohol expectancies, goal-setting, identification of high-risk situations, and skills-training), in aggregate or in combination, influenced the outcomes. Overall, participants were more likely to reduce their alcohol use, heavy drinking frequency, and problems when the intervention provided more rather than fewer intervention components, ps ≤ 01. The total number of intervention components did not moderate the quantity of alcohol consumed during specific intervals (β = 0.26, p =.13) or the frequency of drinking days (β = 0.25, p =.32). As illustrated in Figure 2, interventions that included 4 to 6 components were more successful at reducing the quantity of alcohol consumed (per week/month: d_+ = 0.20, SE = 0.03, 95% CI = 0.14, 0.26), the frequency of heavy drinking (d_+ = 0.16, SE = 0.04, 95% CI = 0.08, 0.23), and alcohol-related problems (d_+ = 0.11, SE = 0.02, 95% CI = 0.06, 0.15). Significant between-group differences (Q_B,) were found for all outcomes (except for the quantity of alcohol consumed during specific intervals or the frequency of drinking days), ps ≤ .01.

Using an iterative approach, we examined whether each intervention component improved the magnitude of the ESs (data not shown). That is, using a sequence of analyses to calculate

[1]Our initial model included all significant moderators of the frequency of heavy drinking; this model fit the data well ($Q_{Regression}$ [6] = 27.88, p <.001; R^2 = 61%) but none of the variables were significant predictors of the frequency of heavy drinking (ps >.12). Because our findings indicated the possibility of multicollinearity, we assessed the variance inflation factor (VIF). The VIF for *goals* was high (VIF = 6.04) and was subsequently removed from the final model. Therefore, the final model included proportion of Black-Americans, intervention delivery (individual vs. group), personalized feedback, moderation strategies, and challenge to alcohol-related expectancies as predictors of the frequency of heavy drinking.

the weighted mean ES, we determined the optimal combination of intervention components. Because personalized feedback and moderation strategies were components implemented in *all* studies that included four or more components, we first calculated the weighted mean ES of interventions that included both components. The other intervention components (i.e., challenges to alcohol expectancies, goal-setting, identification of high-risk situations, and skills-training) were ranked by the frequency of inclusion, highest to lowest, in the set of interventions and then added separately and sequentially, based on their frequency ranking. From these exploratory analyses, for quantity of alcohol used per week/month the magnitude of the ES increased if challenges to expectancies, goal setting, and identification of high-risk situations were included in the intervention (5 components: $d+ = 0.30$ [0.20, 0.40], $k = 4$);[2] for frequency of heavy drinking the ES increased if the intervention also challenged alcohol expectancies and included goal setting (4 components: $d+ = 0.15$ [0.08, 0.23], $k = 5$); and for alcohol-related problems the ES increased when the intervention also included challenges to alcohol expectancies, goal-setting, and identification of high-risk situations (5 components: $d+ = 0.21$ [0.15, 0.27], $k = 7$).

DISCUSSION

Results from this meta-analysis shows that individual- and group-level alcohol interventions targeting first-year college students reduce alcohol consumption and alcohol-related problems for up to four years post-intervention (*Mdn* = 13, range = 0.14 to 208 weeks). Overall, ESs were small (d_+s = 0.07 to 0.14) when interventions were compared with any type of control (including active comparison conditions) but exhibited an incremental increase (d_+s = 0.11 to 0.19) when the intervention was compared to assessment only.

Moderator analyses identified the conditions under which interventions were more (or less) effective. Contrary to expectation, ES magnitude (and intervention efficacy) did not differ by assessment interval (ps >.05) with one exception, namely, frequency of heavy drinking and this result was in the opposite direction; that is, interventions were more successful at decreasing the frequency of heavy drinking when the post-intervention assessments occurred one month or later ($d_+ = 0.07$, 95% CI = 0.02, 0.12; $k = 17$) vs. less than one month ($d_+ = -0.03$, 95% CI = −0.12, 0.05; $k = 11$), Q_B, = 4.52, $p = .03$. This may reflect the fact that the intervention requires some time to "take hold," or it may reflect the methodological need to have a longer time to observe more drinking opportunities.

The heterogeneity of the ESs indicates that alcohol interventions vary in their efficacy. Contrary to predictions, moderator tests showed that sample characteristics (i.e., sex and ethnicity) did not impact the efficacy of interventions for first-year students with one exception: interventions were less successful at reducing the frequency of heavy drinking when they sampled more Black-Americans.

There are two possible explanations for this finding. First, it is possible that interventions have been less culturally appropriate for Black students. To address this possibility, we call

[2]Analyses also indicated that interventions that also include skills training (6 components: $d+ = 0.26$ [0.03, 0.49], $k = 2$) improved the magnitude of the ESs.

for additional formative research to clarify which intervention components may be most appropriate for heavy-drinking Black Americans. For example, Murphy and colleagues reported that Black students responded positively to a personalized face-to-face intervention but not to computerized interventions (Murphy, Dennhardt, Skidmore, Martens, & McDevitt-Murphy, 2010). Second, it is possible that this finding may reflect a methodological limitation (i.e., a restriction of range); that is, because Black students tend to drink less than White students, they have less room for improvement. Surveys of U.S. college students show that Black-Americans are the least likely to engage in heavy drinking (O'Malley & Johnston, 2002). Of the studies examining the frequency of heavy drinking, the median proportion of Black-Americans included in the sample was 5% (range = <1% – 30%). Moreover, due to the limited research sampling Black-Americans, alcohol intervention efficacy for this population is largely unknown. Future research on college alcohol could focus on understanding factors (e.g., culture and community) that may be necessary to enhance the intervention efficacy among heavy-drinking Black-Americans.

Mode of delivery did not impact first-year students' alcohol consumption or alcohol-related problems. Contrary to our expectations, individually delivered interventions were no more effective than group-based interventions with one exception: frequency of heavy drinking. Interventions delivered to individuals (vs. groups) were more effective at reducing the frequency of heavy drinking compared with controls. Our findings suggest that implementing group-based interventions among first-year college students may be a cost-effective strategy to prevent alcohol misuse on college campuses but heavy drinkers may require individually delivered tailored interventions. In contrast to our hypothesis, face-to-face (vs. computer-delivered) interventions were no more likely to reduce first-year students' consumption or alcohol-related problems. The finding that computer-delivered interventions are as effective as face-to-face interventions is encouraging given their easy dissemination and lower cost. Our findings are consistent with the broader college drinking literature showing that computer-delivered interventions are efficacious (Carey, Scott-Sheldon, Elliott, Bolles, & Carey, 2009). Taken together, the efficacy of alcohol-focused interventions for most first-year students does not appear to be dependent on delivery mode.

Moderator tests suggest, consistent with our hypotheses, that several intervention components (i.e., providing individuals with personalized feedback on consumption, problems, or risks; strategies to moderate their drinking behavior; challenges to alcohol-expectancies, and encouraging students to set alcohol-related goals) help first-year students to reduce their quantity and frequency of alcohol use. Prior research suggested that providing college students with personalized feedback on their alcohol use is particularly effective (Walters & Neighbors, 2005). Also effective, and frequently packaged with personalized feedback, is providing strategies for modifying risky drinking behavior (Dimeff, Baer, Kivlahan, & Marlatt, 1999). Setting drinking limits often occurs as part of a face-to-face motivational interview but students may be encouraged to set drinking limits in the absence of a facilitator (Walters, Miller, & Chiauzzi, 2005). Our results show that challenging alcohol-related expectancies is effective in reducing the frequency of heavy drinking and alcohol-related problems. Providing interventions that challenge students' alcohol expectancies prior to engaging in high-risk drinking behaviors may be particularly

helpful given the relatively brief effects of expectancy challenge interventions (Scott-Sheldon, Terry, Carey, Garey, & Carey, 2012).

In exploratory analyses, we find that combining several intervention components further reduces drinking and related problems. Interventions with four or more components, identified as significant moderators of consumption and/or problems, were the most effective at reducing first-year students' alcohol consumption and alcohol-related problems (Figure 2). Thus multi-component interventions appear to be worthy of consideration (even at greater time and/or cost) because they produce stronger effects. Across all of the studies in this meta-analysis that included four or more intervention components, two constant features were found: provision of personalized feedback and moderation strategies. Personalized feedback about alcohol consumption, problems, and risks, and accompanying modification strategies, form the core of multi-component interventions that reduce alcohol misuse. Other intervention components, including challenges to alcohol-related expectancies, goal-setting, and identification of high-risk situations, were also effective strategies. More research is required to fully explore intervention components both necessary and sufficient to reduce first-year students' alcohol misuse.

Limitations

Several limitations of the research should be considered when interpreting our findings. First, as with any meta-analysis, identifying relevant studies are restricted by publication source, authors' choice of keywords, and researchers' responses to requests for papers and/or data through listservs or direct communications (Matt & Cook, 1994). To optimize the inclusion of relevant studies, we undertook an exhaustive search (e.g., searching electronic databases on two separate occasions). Second, all outcomes involve self-reports, which are vulnerable to measurement (e.g., text, formatting, and context), cognitive (e.g., memory), and social (e.g., self-presentation) biases (Schroder, Carey, & Vanable, 2003). Researchers typically use methods to minimize these biases and maximize data quality (Del Boca & Noll, 2000). Finally, our moderator tests were limited to the data available in the individual studies. Thus, we were unable to explore factors (e.g., sensation seeking, parental influences, drinking game participation) that have been associated with alcohol use during the first year of college (Borsari et al., 2007).

Summary and Clinical Implications

The results of this meta-analysis confirm that behavioral interventions for first-year college students are successful at reducing alcohol consumption and alcohol-related problems. Given these findings and the potential to avoid potentially serious and costly consequences, we recommend two strategies to prevent alcohol misuse among first-year students.

First, we suggest that all incoming college students undergo routine screening for risky alcohol use within the first few weeks on campus. This time period marks an important transition that often coincides with the heavy alcohol use for some first-year students (National Institute on Alcohol Abuse and Alcoholism, 2002). Such screening can be brief and done electronically, minimizing the burden on institutions and students. Such an assessment could be nested within a larger quality of life and campus adjustment survey.

Second, students who report drinking on the screening, we recommend a brief, proactive intervention with components identified as helpful in this meta-analysis. Thus, consistent with our findings and prior research (Walters & Neighbors, 2005), the intervention should provide personalized drinking feedback, delivered via computer. Computer-based feedback is equivalently effective with face-to-face interventions and several computer-based interventions have been developed. Thus, such interventions can be delivered efficiently at relatively low cost (Walters, Miller, et al., 2005). Consistent with our findings and with a harm-reduction approach, interventions could also encourage first-year students to identify high-risk situations, such as off-campus parties or spring break vacations, in which negative alcohol-related consequences often occur (Marlatt, 1996). Finally, interventions for students who drink should provide protective behavioral strategies for responsible and safe drinking (Dimeff et al., 1999). In our analyses, providing concrete suggestions, such as alternating between alcoholic and non-alcoholic beverages, moderated the frequency of heavy drinking. Experienced drinkers employ protective behavioral strategies (Sugarman & Carey, 2009), but first year students are often less experienced with drinking and may benefit from more explicit guidance. Information on moderation strategies could be distributed before periods when students are more likely to engage in at-risk drinking behavior (e.g., Fall semester, spring break) (Del Boca, Darkes, Greenbaum, & Goldman, 2004). Finally, interventions should encourage students to set harm reduction goals to manage their drinking behaviors (e.g., setting a blood alcohol concentration limit). Consistent with previous research (e.g., (Gollwitzer, 1999; Gollwitzer & Sheeran, 2006), our meta-analyses showed that generating harm prevention plans and/or goal-setting significantly improved the efficacy of the intervention to reduce quantity and frequency of alcohol use.

Universal screening and proactive intervention delivery will not prevent all alcohol-related harms on campus; however, such prevention-oriented approaches are low-cost, highly efficient, and minimally burdensome on students and campuses. This meta-analytic research supports their efficacy and, even though effect sizes are relatively small, the “prevention paradox” reminds us that achieving small reductions in alcohol misuse among a large group of drinkers can result in greater campus gains relative to more expensive efforts to reduce problems amongst a much smaller number of dependent drinkers Rose (1985).

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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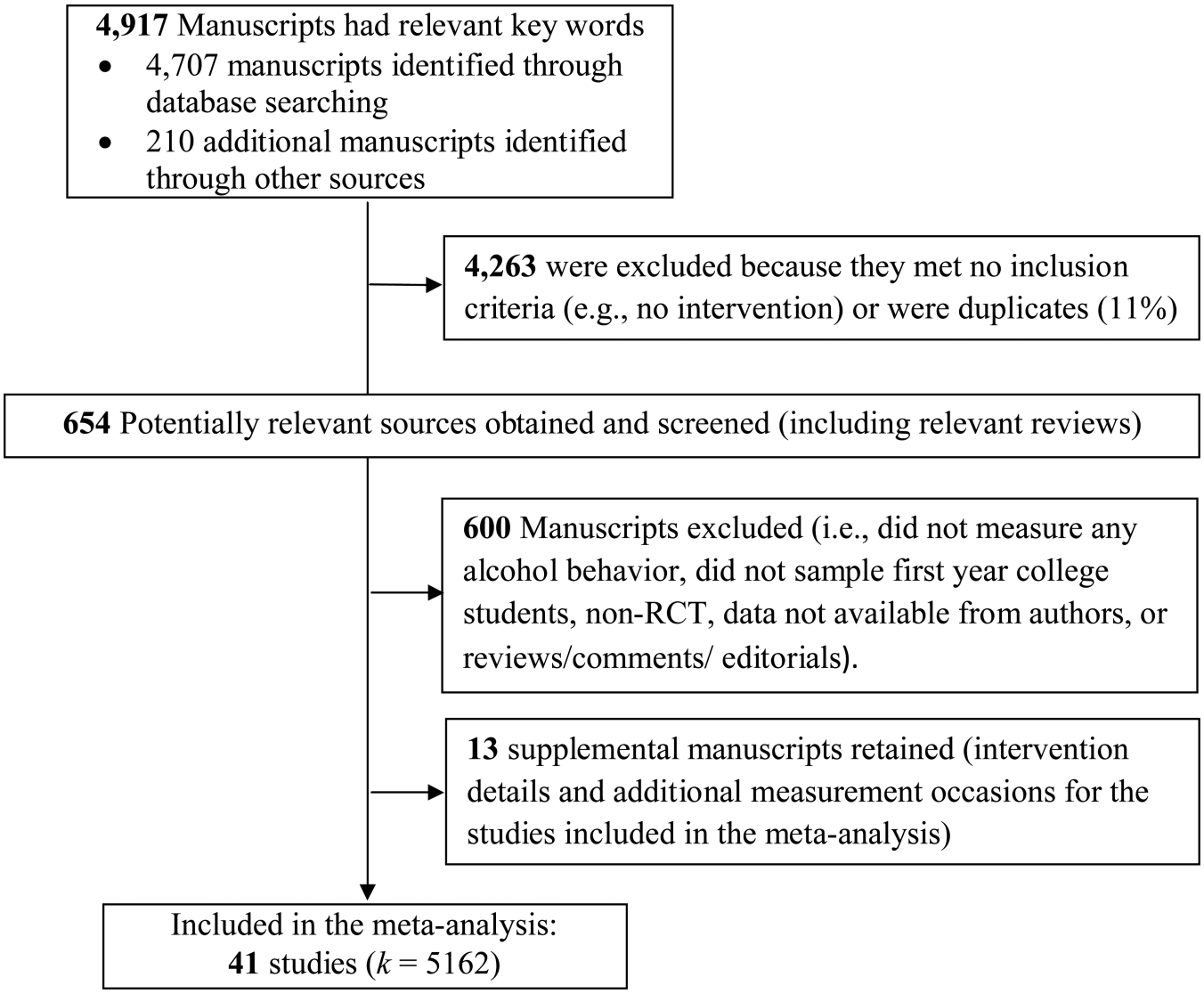

Figure 1.
Selection and Retrieval of Studies.

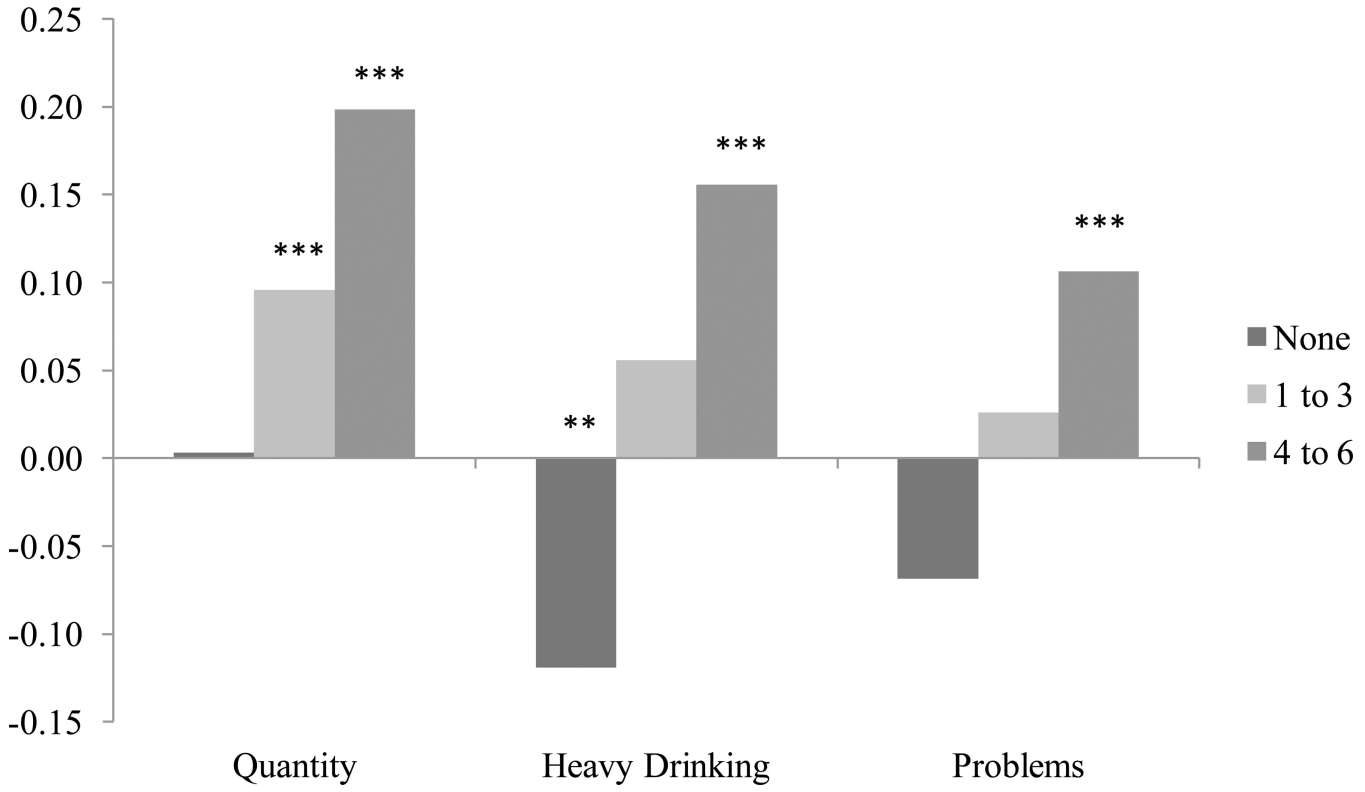

Figure 2.

The Impact of the Number of Components on Quantity and Frequency of Alcohol Use and Alcohol-Related Problems.

***p* <.01. ****p* <.001

Table 1

Characteristics of the 41 RCTs (62 Interventions) Included in the Meta-analysis

DESIGN AND MEASUREMENT	
Recruitment, %	
Volunteered	49
Recruited	46
Mandated	2.5
Multiple	2.5
Assessments, *M* (*SD*)	1.88 (2.12)
Study Quality (0 to 20), *M* (*SD*)	11.74 (2.48)
SAMPLE CHARACTERISTICS	
Sample size	24,294
Retention, *M* % (*SD*)	76 (20)
Sex, % women	57
Age, *M* (*SD*)	19 (1)
Ethnicity, %	
White	77
Black or African-American	9
Hispanic or Latino	6
Asian	8
Alcohol use, *M* % (*SD*)	85 (20)
Greek members, % (*n* = 7)	30
University, no. of studies	
Public	31
Private	8
Public and private	1
Size of Institution, %	
Small (<5,000)	3
Medium (5,000 to 15,000)	26
Large (>15,000)	71
INTERVENTION CHARACTERISTICS	
Dose, *Mdn* (range)	
Sessions	1 (1–8)
Minutes	43 (4–120)
Delivery method, %	
FTFI	37
CDI	32
Computer-facilitated FTFI	12
Postal/electronic mail	10
FTFI and CDI/Mail	8
Written	3
Commercially available, %	52

DESIGN AND MEASUREMENT	
Delivery, %	
Individual	61
Group	31
Both individual and group	8
Group size, *Mdn* (range)	15 (7–32)
Group composition, %	
Same-sex	15
Mixed-sex	85
Facilitators, *Mdn* (range)	1 (0–4)
Facilitators, %	
Peers/parents	20
Professionals-in-training	10
Multiple	26
None	44
Theory-driven, %	73
Targeted to group, %	15
Tailored to individual, %	65
Intervention Components	
Alcohol/BAC education, %	77
Normative comparisons, %	84
Personalized feedback, %	
Consumption	73
Problems	58
Risks	50
Moderation strategies, %	63
Challenges to expectancies, %	47
Goal-setting, %	
Focus on high-risk situations, %	27
Writing/journaling, %	19
Skills training, %	18
Decisional balance exercise, %	13
Values clarification, %	11
Provided materials, %	
Generic	19
Tailored	35
Boosters/relevant materials	16
Delivered onsite, %	55
Controls	
Active control, %	42
Dose, *Mdn* sessions/minutes	1/38

Note. RCT, randomized controlled trial. FTFI, face-to-face intervention. CDI, computer-delivered intervention.

Table 2

Weighted mean effect sizes and related statistics at the final assessment for interventions targeting first-year college students.

		d_+ (95% CI)		Homogeneity		
Outcome	***k***	**Fixed effects**	**Random effects**	***Q***	***p***	**I^2 (95% CI)**
Alcohol consumption						
Quantity, per week/month	42	**0.12 (0.08, 0.16)**	**0.13 (0.07, 0.19)**	68.63	.004	40 (13, 59)
Quantity, specific intervals/drinking day	20	**0.11 (0.07, 0.16)**	**0.14 (0.07, 0.21)**	34.32	.017	45 (6, 67)
Frequency of drinking days	15	**0.07 (0.03, 0.12)**	**0.07 (0.02, 0.13)**	15.64	.336	10 (0, 48)
Frequency of heavy drinking	28	0.04 (−0.01, 0.08)	0.07 (−0.01, 0.14)	62.65	<.001	57 (34, 72)
Alcohol-related problems	34	**0.07 (0.03, 0.10)**	0.06 (−0.03, 0.15)	156.84	<.001	79 (71, 85)

Note. Weighted mean effect sizes (d_+) are positive for differences that favor the intervention relative to the control group. *k*, number of interventions; d_+, weighted mean effect size; *CI*, confidence interval; *Q*, homogeneity statistic; I^2, consistency of effect sizes. Bold font indicates significant weighted mean effect sizes. Table 3

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Table 3

Weighted mean effect sizes at the final assessment for interventions by comparison condition

	Interventions vs. Assessment Only		Interventions vs. Active Comparison		Comparisons Between Control Types	
Outcome	***k***	***d*+ (95% CI)**	***k***	***d*+ (95% CI)**	**Q_B,**	***p***
Alcohol Consumption						
Quantity, per week/month	24	**0.18 (0.13, 0.24)**	18	0.01 (−0.08, 0.09)	8.55	.003
Quantity, specific intervals/drinking days	15	**0.19 (0.10, 0.27)**	5	0.04 (−0.05, 0.14)	3.04	.081
Frequency of drinking days	8	**0.11 (0.03, 0.19)**	7	0.04 (−0.04, 0.11)	1.91	.166
Frequency of heavy drinking	18	**0.13 (0.05, 0.21)**	10	**−0.11 (−0.20, −0.01)**	7.18	.007
Alcohol-related problems	22	**0.13 (0.02, 0.24)**	12	−0.08 (−0.16, 0.01)	5.79	.016

Note. Assessment only refers to wait list/no treatment/assessment only comparisons (58%). Active comparisons refer to comparisons with alcohol education (3%), alcohol-related content (time-matched, 18%; not matched, 16%), or other content (time-matched, 5%). *k*, number of interventions; *d*+, weighted mean effect size (fixed effects); *CI*, confidence interval; Q_B, between-group homogeneity statistic. Bold font indicates significant effects; font in bold and gray indicate the effects sizes are heterogeneous (*p*s ≤.05).

Table 4

Moderators of quantity and frequency of alcohol use and alcohol-related problems

	Quantity, Week/Month		Quantity, Intervals/Days		Frequency of Drinking Days		Frequency of Heavy Drinking		Alcohol-related Problems	
Sample Characteristics	**β**	***p***	**β**	***P***	**β**	***p***	**β**	***p***	**β**	***p***
Sex	−0.17	.15	−0.29	.10	−0.18	.48	−0.15	.25	**0.20**	**.01**
Ethnicity										
% White	0.03	.82	0.09	.63	0.23	.39	−0.16	.22	**0.20**	**.01**
% Black	0.12	.51	−0.72	.08	−0.09	.82	**−0.45**	**<.01**	−0.16	.26
Prior alcohol use	0.09	.68	**0.68**	**.02**	0.39	.18	0.08	.70	**0.32**	**.02**
Intervention Delivery										
Individual vs. group	0.08	.52	0.23	.19	0.23	.37	**0.40**	**<.01**	0.08	.35
FTF vs. CDI	−0.26	.11	−0.14	.45	−0.14	.69	**−0.37**	**<.01**	**−0.22**	**<.01**
Intervention Components										
Alcohol education	0.03	.82	−0.30	.08	0.15	.54	−0.02	.89	0.08	.30
Normative comparisons	0.01	.93	0.29	.09	−0.07	.78	0.17	.19	0.16	.04
Personalized feedback	**0.56**	**<.01**	**0.41**	**.02**	**0.52**	**.04**	**0.57**	**<.01**	**0.24**	**<.01**
Moderation strategies	0.21	.08	0.36	.04	−0.05	.85	**0.57**	**<.01**	0.09	.26
Challenges to alcohol expectancies	0.14	.26	0.16	.35	0.32	.20	**0.52**	**<.01**	**0.46**	**<.01**
Goal-setting	**0.44**	**<.01**	0.17	.32	0.13	.61	**0.54**	**<.01**	**0.20**	**.01**
Identification of high-risk situations	**0.36**	**<.01**	−0.14	.40	0.13	.61	**0.35**	**<.01**	0.12	.13
Skills training	−0.21	.09	0.27	.12	0.21	.42	0.04	.75	**−0.36**	**<.01**
Decisional-balance exercises	0.11	.35	−0.12	.48	0.27	.29	0.19	.13	−0.02	.80

Note. Fixed-effects regression models used the inverse of the variance for each effect size as weights. Reported coefficients (β) are standardized. Bold typeface values are significant; values underlined are significant after adjusting the *p*-value for the number of statistical tests performed (Bonferroni; $p < .003$). Moderators that were significant using mixed-effects models are in gray font. Potential moderators with missing values indicate all observations contained identical values.