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Individual-Level Interventions to Reduce College Student Drinking: A Meta-Analytic Review

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Abstract

In light of increasing numbers of controlled studies evaluating alcohol abuse prevention interventions for college drinkers, we conducted a meta-analysis to summarize the current status of the literature. The meta-analysis includes 62 studies, published between 1985-early 2007, with 13 750 participants and 98 intervention conditions. All studies were content coded for study descriptors, participant characteristics, and intervention components. We derived weighted mean effect sizes for alcohol interventions versus comparison conditions for consumption variables and alcohol-related problems, over four measurement intervals. Over follow-up intervals lasting up to 6 months, participants in risk reduction interventions drank significantly less relative to controls. Students receiving interventions also reported fewer alcohol-related problems over longer intervals. Moderator analyses suggest that individual, face-to-face interventions using motivational interviewing and personalized normative feedback predict greater reductions in alcohol-related problems. Implications for future research include attention to maintenance of effects, and developing more efficacious interventions for at-risk college drinkers.

Keywords

meta-analysis; college students; alcohol drinking; binge drinking; randomized clinical trials; intervention

1. Introduction

Young adults between the ages of 18-25 report high rates of alcohol consumption, including heavy episodic (binge) drinking, defined as consuming five or more drinks at a time (Substance Abuse and Mental Health Services Administration [SAMHSA], 2006). Compared to their peers not attending college, college students consume larger quantities of alcohol on drinking occasions (SAMHSA, 2006), and as many as 43% of undergraduates report heavy episodic drinking at least once in the last two weeks (Wechsler et al., 2002). Heavy episodic drinking increases risks for social and academic problems as well as risks for unintended injuries, assault, and death (Hingson, Heeren, Winter, & Wechsler, 2005; Wechsler et al., 2002). *Healthy People 2010*, a report outlining national priorities in health promotion and disease prevention, characterized heavy episodic drinking by young adults as a major national health problem (U.S. Department of Health and Human Services, 2000). This report set an objective of reducing binge drinking among college students to 20% by 2010.

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More than 4000 colleges and universities in the United States enroll more than 14 million undergraduate students (National Center for Education Statistics, 2005), many of whom are younger than the minimum legal drinking age of 21. Institutions of higher education are charged with upholding state and local laws, as well as promoting safe living and learning environments. A recent survey of college administrators from 747 institutions revealed that all campuses engaged in some form of alcohol abuse prevention programming; 90% provided counseling and treatment services for students, and nearly as many provided prevention services (e.g., alcohol education) for freshmen or other at-risk groups (Wechsler, Seibring, Liu, & Ahl, 2004). Given the universal nature of these prevention efforts and the numbers of students affected, it is important that college and university administrators have access to information regarding empirically-supported interventions to prevent alcohol abuse.

Several qualitative reviews have summarized the results of studies evaluating interventions to reduce heavy drinking among college students. For example, Larimer and Cronce (2002) reviewed 32 studies and found evidence of efficacy for some individual-level interventions (e.g., brief motivational interventions, cognitive-behavioral skills training) but not for others (e.g., alcohol education). More recent qualitative reviews support the efficacy of feedback-based interventions (Walters & Neighbors, 2005) and interventions for mandated students (Barnett & Read, 2005) in producing within-groups reduction on consumption and problems. A review of the literature on computer-administered alcohol prevention programs for college students found only two controlled studies with behavioral outcomes (Walters, Miller, & Chiauzzi, 2005). However, the numbers of publications in peer-reviewed journals has burgeoned in the last decade, and the numbers of controlled studies that allow strong inference are now sufficient to support a meta-analysis of this literature. A meta-analysis can clarify the current status of the efficacy literature, and help to guide future research.

This meta-analysis includes published studies that evaluated individual-level interventions designed to reduce alcohol use by college students. We recognize that limiting a review to published studies potentially excludes information (i.e., the file-drawer effect; Rosenthal, 1979); however, publication in a peer-reviewed journal serves as a proxy indicator of minimum methodological quality. To be included, studies needed to (a) be designed to reduce alcohol use and/or consequences in college drinkers; (b) use random assignment to intervention conditions, including a control condition; and (c) report behavioral outcomes related to alcohol consumption and/or alcohol-related problems. Excluded are studies evaluating interventions not administered to individuals, where the dose received could not be determined (i.e., campus-wide media or social norms campaigns).

Three decisions guided this meta-analysis. First, we report between-groups effects rather than within-groups effects; this decision recognizes that college drinking fluctuates over the course of an academic semester (Del Boca, Darkes, Greenbaum, & Goldman, 2004) as well as across years in college (e.g., Baer et al., 2001). Focusing on between-groups effects controls for maturation and historical variables; thus, we use a stringent test of efficacy to establish whether interventions influence college drinking *beyond what would be expected from naturally occurring change* (Campbell & Stanley, 1963). Second, we present effect sizes for multiple consumption variables and for alcohol-related problems; we aim to clarify the extent to which interventions produce changes on measures of consumption quantity, drinking frequency, indices of intoxication, and/or negative consequences resulting from drinking. Third, we evaluate effect sizes separately for follow-ups of different durations. This decision allows conclusions regarding the maintenance or duration of intervention effects. We predict that alcohol risk reduction interventions for college drinkers will produce significant between-groups effects, that risk reduction will be observed both on alcohol consumption and alcohol-related consequences, and that effects will be apparent relatively soon after intervention exposure.

When significant and heterogeneous effect sizes emerge from our meta-analysis, we plan to conduct exploratory analyses to evaluate what intervention and student characteristics predict alcohol risk reduction. The interventions obtained for this review vary with respect to theoretical underpinnings, intervention content, mode of administration (e.g., computer vs. in-person), length (one vs. multiple sessions), format (group vs. individual), and degree of tailoring. In addition, study participants vary by year in school, gender and racial/ethnic composition, and volunteer or mandated status. A meta-analysis can address whether these potential moderators influence the magnitude of effect sizes. Results from moderator analyses will allow us to draw empirically-informed conclusions regarding types of interventions and student characteristics associated with intervention efficacy.

2. Method

2.1 Search strategy and study selection

Several strategies were used to search for relevant published (or in press) manuscripts: (a) electronic reference databases (PsycINFO, PubMED, ERIC, CRISP, and the Cochrane Library) using a Boolean search strategy with the following abbreviated and full keywords: (alcohol OR drink* OR binge) AND (college OR university) and (intervention OR prevention) and (random* OR control*); (b) reference sections of relevant review or published studies; (c) examining online contents of relevant journals (e.g., *Addiction*, *Addictive Behaviors*), and (d) sending requests for published or in press manuscripts to authors.

Published (or in press) studies were included if they (a) examined any educational, behavioral, or psychological alcohol intervention; (b) sampled college or university students; (b) used a randomized controlled trial (RCT) or a quasi-experimental design with a control group; (c) assessed drinking behavior (e.g., frequency or quantity); and (d) provided sufficient information to calculate between-group effect size estimates. Consistent with these criteria, studies were excluded if the intervention did not specifically focus on alcohol (e.g., comprehensive drug and alcohol intervention; McCambridge & Strang, 2004), included non-college participants and the results were not separated (e.g., Monti et al., 1999), did not include an adequate control or comparison condition, did not measure any alcohol behavior, or provided insufficient statistical information to calculate effect sizes. When studies reported insufficient study content or statistical details, study author(s) were contacted for additional information. Of the 17 authors contacted, 94% responded resulting in the retention of 15 studies and the exclusion of 2 studies. Studies that fulfilled the search criteria and were available as of March 9, 2007 were included.

In some cases, several publications provided information about the same intervention or outcomes (e.g., an author may have published the results from the 6-month and 1-year follow-up in separate publications). In these instances, information from multiple publications reporting on the same sample was pooled for content coding, and effect sizes were calculated separately for each measurement occasion. When more than one control or comparison condition was used (e.g., standard education and wait-list), the control condition with the least contact (e.g., wait-list) was used as the comparison condition to facilitate interpretation of intervention effects. Using these criteria, 62 manuscripts with 98 separate interventions (*k*) qualified for the meta-analysis (Figure 1).

2.2 Study Outcomes

For each study, effect size estimates were calculated from the information provided in the report (s). Effect sizes were calculated for alcohol-related behaviors and problems. Specifically, the *alcohol consumption* outcomes included: (a) quantity consumed over a period time (e.g., week, month), on specific occasions (e.g., Friday night, birthday), and per drinking day; (b) maximum

quantity consumed on a single occasion; (c) frequency of heavy drinking, usually defined as 5 or more drinks for men and 4 or more drinks for women (Wechsler, Davenport, Dowdall, Moeykens, & Rimm, 1995); (d) frequency of drinking days, (e) peak and/or typical blood alcohol concentration (BAC); and (e) composite alcohol consumption (when multiple indicators of alcohol use were combined). *Alcohol-related problems* were typically operationalized using multi-item scales.

2.3 Coding and Reliability

Two researchers independently coded overall study information (e.g., publication year), sample characteristics (e.g., ethnicity, gender, age), target group (e.g., heavy drinkers, Greek members, freshmen), design and measurement specifics (e.g., recruitment method, number of follow-ups), and content of control and intervention condition(s) (e.g., number of sessions, intervention content). Twenty studies were randomly selected to evaluate interrater reliability. For the categorical dimensions, raters agreed on 55% to 100% of the judgments (mean Cohen's kappa = .67). Reliability for the continuous variables was calculated using the intraclass correlation coefficient (ρ); ρ ranged from .40 to 1.00, with an average $\rho = 0.90$ across categories (*Mdn* = 0.98). Because all studies were double-coded, disagreements were resolved through discussion.

2.4 Effect Size Derivation

Because the majority of the outcomes were continuous rather than dichotomous, effect sizes (*d*) were calculated as the mean differences between the treatment and control group divided by the pooled standard deviation (Cohen, 1988). If the pooled *SD* was unavailable or could not be derived from the reported statistics, the denominator was instead another form of *SD* (e.g., the *SD* of the paired comparisons). When means and standard deviations were unavailable, other statistical information (e.g., *t*- or *F*-values) was used (Johnson & Eagly, 2000; Lipsey & Wilson, 2001). If a study reported dichotomous outcomes (e.g., frequencies), we calculated an odds ratio and transformed it to *d* using the Cox transformation (Sánchez-Meca, Marín-Martínez, & Chacón-Moscoso, 2003). If no statistical information was available (and could not be obtained from the authors) and the study reported no significant between-group differences, we estimated that effect size to be zero (Lipsey & Wilson, 2001). In calculating *d*, we controlled for baseline differences when pre-intervention measures were available, and effect sizes were corrected for sample size bias using Hedges' correction (Hedges, 1981). A positive sign indicated that participants in the treatment group decreased their alcohol consumption or problems compared to controls. Effect sizes were calculated using DSTAT 2.0 (Johnson & Wood, 2006).

We calculated multiple effect sizes from individual studies when they had more than one outcome, multiple intervention conditions, or when outcomes were separated by sample characteristics (e.g., gender). Effect sizes calculated for each intervention and by sample characteristic were analyzed as a separate study (Lipsey & Wilson, 2001). When a study contained multiple measures of the same outcome (e.g., alcohol-related problems measured using three separate items), the effect sizes were averaged.

2. 5 Statistical Analysis

Each set of effect sizes (i.e., for each dependent variable) was examined first for extreme outliers, resulting in the exclusion of 10 out of 394 effect sizes across the 30 dependent variables where $k \geq 5$ (see Table 2)[i]. After excluding the outliers, weighted mean effect sizes, d_+s, were calculated using fixed- and random-effects procedures (Lipsey & Wilson, 2001), such that individual studies' effect sizes were weighted by the inverse of their fixed- or random-effects. Effect size analyzes were conducted in Stata 9.0 (StataCorp, 2005) using macros provided by Lipsey and Wilson (2001).

The homogeneity statistic, *Q*, was computed to determine whether each set of d_+s shared a common effect size. The homogeneity of variance statistics has an approximate chi-square distribution with the number of effect sizes (*k*) minus 1 degrees of freedom (Hedges & Olkin, 1985); a significant *Q* indicates a heterogeneous relationship. To further assess heterogeneity, the I^2 index was calculated, to assess the proportion of total variability in a set of effect sizes attributable to true heterogeneity (Higgins & Thompson, 2002; Huedo-Mendina, Sanchez-Meca, Marin-Martinez, & Botella, 2006). Percentages of 25%, 50%, and 75%, are considered low, medium, and high heterogeneity respectively (Higgins, Thompson, Deeks, & Altman, 2003). The I^2 index and corresponding 95% uncertainty intervals which were calculated using published formulas (Higgins & Thompson, 2002). If the 95% uncertainty interval around the I^2 index includes a zero, the set of effect sizes are considered homogeneous.

If *Q* remained significant after the exclusion of outliers, or the I^2 index (and corresponding 95% uncertainty interval) indicated that a medium-to-large amount of between-studies variability could be explained, the relation between study characteristics and the magnitude of the effects was examined using a modified least squares regression analysis. Consistent with meta-analytic procedures (e.g., Hoffman, Papas, Chatkoff, & Kerns, 2007; Prendergast, Urada, & Podus, 2001; Scott-Sheldon & Johnson, 2006), moderator tests were conducted only if the dependent variable consisted of a minimum of six effect sizes.

3. Results

3.1 Description of Studies

Table 1 provides sample characteristics, target group, and intervention details for the 62 included studies. Studies appeared between 1985 and early 2007; the median publication year was 2004. All were written in English and were published (or in press) in journals. Studies were conducted predominately in the United States (85%). Most studies were conducted at public universities (72%) of large size (>10,000; 89%). Participants typically volunteered (71%; e.g., experimental credit or self-selection from community) to participate, although some were recruited (19%; e.g., letters sent by college official to entering freshman) or mandated for violating alcohol policy (10%). Studies usually targeted a specific group (89%), mostly heavy drinkers (65%).

All studies randomly assigned participants or groups of participants (e.g., classrooms) to intervention conditions; 94% evaluated participants at both pre- and post-test with an average of 1.58 (*SD* = 0.86) follow-ups after baseline (range = 1 to 5; *Mdn* = 1). The first post-intervention assessment period occurred an average of 6.69 weeks (*SD* = 10.92, range = 0 to 52 weeks; *k* = 97) after the intervention, the next assessment took place 22.70 weeks (*SD* = 22.06; range = 3 to 104 weeks; *k* = 46) post-intervention, the third averaged 52.30 weeks (*SD* = 19.88; range = 24 to 91 weeks; *k* = 10) post-intervention, and the fourth averaged 82.33 weeks (*SD* = 52.54; range = 52 to 143 weeks; *k* = 3) post-intervention, with a single follow-up reported at 195 weeks (*k* = 1). Because the timing of follow-ups varied widely across studies, we divided outcomes into four measurement intervals: (a) immediate posttest (assessments ≤ 3 weeks; *k* = 43), (b) short-term follow-up (4 to 13 weeks; *k* = 61), (c) intermediate follow-up (14 to 26 weeks; *k* = 24), and (d) long-term follow-up (27 to 195 weeks; *k* = 20).

[i]Although there are no formal guidelines regarding the minimum number of effect sizes necessary to calculate weighted mean effect sizes, outcomes with fewer than five interventions at a measurement interval are not reported due to potential interpretation bias from a single intervention. This resulted in the exclusion of typical BAC at immediate (*k* = 0), short-term (*k* = 2), and intermediate (*k* = 1) follow-up; maximum quantity at intermediate (*k* = 3) and long-term (*k* = 1) follow-up; and composite alcohol consumption at immediate follow-up (*k* = 4). None of the weighted mean effect sizes (when $k \geq 2$) were significant.

3.2 Description of Samples

A total of 13 750 college students participated in the studies, with a retention rate of 75% at follow-up (based on the largest available *n* at any follow-up). Studies sampled about equal numbers of males (53%) and females (47%) and 81% White participants with a mean age of 20.37 years (*SD* = 1.98; range = 18 to 26). Of the 39 studies reporting participants' year in college, most were freshman (66%) or sophomores (17%). Eleven studies reported participants' Greek membership status; of these, 91% of the samples consisted of Greek members and/or pledges.

3.3 Description of Intervention Conditions

In the 62 studies included in the meta-analysis, 98 separate intervention conditions were evaluated. Studies consisted of an average of 1.87 (*SD* = 1.05; range = 1 to 5; *Mdn* = 2) intervention conditions. Most interventions involved face-to-face delivery by a facilitator to an individual or a group (70%), with a minority using computer or print delivery (22%), or a combination (7%). Furthermore, interventions delivered in groups (44%) consisted of a median of 2 sessions, of 50 minutes each, with a median of 1 facilitator and 9.8 participants; individually delivered interventions (40%) consisted of a median of 2 sessions, of 50 minutes each, with a median of 1 facilitator and 1 participant; and interventions with no face-to-face contact (e.g., computer/internet, mailing; 30%) consisted of a median of 1 session of 15 minutes with no facilitators and 1 participant.

Most interventions were informed by theory (82%) and guided by manuals (61%); manuals were used in 66% of the interventions delivered face-to-face, 46% of the interventions delivered via computer or print, and 57% of the combined intervention delivery modes. Motivational interviewing techniques were used in 44% of the interventions. Intervention components frequently included alcohol/BAC education (73%), normative comparisons (56%), and feedback on consumption (49%); they often included moderation strategies (43%), feedback on problems (37%), goal setting (35%), or feedback on expectancies and/or motives (34%). Less frequent components included identification of high-risk situations (24%), decisional balance exercises[ii] (17%), skills-training (16%), an expectancy challenge[iii] (12%), or values clarification[iv] (7%). Alcohol-related materials (e.g., brochures, pamphlets) were provided in 47% of the interventions. Intervention content was typically tailored to the participants (86%); tailoring occurred at the level of the individual (56%, e.g., personalized feedback), the group (27%; e.g., Greeks or freshmen), or to both the individual and group (3%). Of the 73 interventions delivered face-to-face, session leaders were professionals-in-training (66%), professionals (21%), peers (18%), or paraprofessionals (12%); some interventions used more than one type of facilitator.

3.4 Description of the Comparison Conditions

Risk reduction interventions were compared most often to a no-treatment condition (i.e., assessment-only, 55%); active comparison conditions involved a time-matched irrelevant intervention (16%), time-matched relevant intervention (10%), briefer but relevant

[ii]Decisional balance refers to an exercise in which pros and cons (or costs and benefits) of a behavior are elicited and discussed. Often pros and cons of change options are also elicited, and the overall "balance" between continuing the behavior (e.g., high risk drinking) and the change option (e.g., drinking less) is evaluated (e.g., Dimeff et al., 1999).

[iii]Expectancy challenge is an intervention designed to illustrate the effects of alcohol-related expectancies through experiential learning. As originally developed by Darkes and Goldman (1993), the procedure involves providing beverages to groups of drinkers into a bar-like setting; some contain alcohol and others contain a placebo beverage, but the participants do not know the content of their drinks. They engage in activities that promote social interaction, and after time passes, participants guess who was drinking alcohol versus a placebo. Incorrect identification provides opportunities to consider the effects of alcohol attributable to expectancies. The procedure may be repeated, and information about the effects of alcohol may also be provided.

[iv]Values clarification refers to exercises designed to help participants identify their values and attitudes regarding alcohol (particularly about the acceptability of drinking or certain types of drinking), and to explore how they express those values in their behavior.

intervention (10%), or alcohol education (8%). Of the 44 interventions using an active comparison condition, these typically consisted of an individual session lasting 20 minutes. Alcohol education materials were provided to 29% of the control/comparison conditions.

3.5 Intervention Effects

Table 2 provides the weighted mean effect sizes by measurement interval comparing interventions with any comparison condition.[v] At immediate follow-up, intervention participants reduced their quantity of drinking (d_+ = 0.19, 95% CI 0.07, 0.32), frequency of heavy drinking (d_+ = 0.17, 95% CI 0.03, 0.31), and peak BAC (d_+ = 0.41, 95% CI 0.26, 0.57) compared to controls. All of these effects were parallel using fixed- or random-effects assumptions. Homogeneity analyses (*Q*) indicated that the effects for drinking quantity and frequency of heavy drinking were homogenous (*p*s >.05); examination of the I^2 index also confirmed homogeneity. Although significant heterogeneity was found for peak BAC, Q (4) = 11.66, p = .02, and examination of the I^2 index indicated moderate heterogeneity, the small number of effect sizes (k = 5) precluded moderator analyses.

Results for the short-term follow-up (4 – 13 weeks post-intervention) showed that intervention participants reduced their quantity of drinking (d_+ = 0.13, 95% CI 0.06, 0.19; Figure 2), quantity for specific time intervals/drinking days (d_+ = 0.13, 95% CI 0.05, 0.21), frequency of heavy drinking (d_+ = 0.18, 95% CI 0.10, 0.26), peak BAC (d_+ = 0.13, 95% CI 0.04, 0.21), and alcohol-related problems (d_+ = 0.15, 95% CI 0.08, 0.21; Figure 3). Again, these effects were parallel using fixed- or random-effects assumptions. All significant effects were homogenous except for alcohol-related problems, Q (30) = 45.27, p = .04. The I^2 index for alcohol-related problems indicated a low to moderate level of heterogeneity (34%); however, the uncertainty interval for the I^2 index contained a zero suggesting true homogeneity. Nonetheless, when the results of the Q and I^2 index do not agree, moderator analyses are recommended (T. B. Huedo-Mendina, personal communication, March 21, 2007).

At intermediate follow-up (14 – 26 weeks post-intervention), intervention participants reduced quantity of alcohol consumed (d_+ = 0.11, 95% CI 0.02, 0.20), quantity for specific time intervals/drinking days (d_+ = 0.19, 95% CI 0.08, 0.31), and frequency of heavy drinking (d_+ = 0.11, 95% CI 0.01, 0.22). They also reduced alcohol-related problems (d_+ = 0.22, 95% CI 0.12, 0.32) compared to control participants.

At long-term follow-up (27 – 195 weeks post-intervention), frequency of drinking days (d_+ = 0.16, 95% CI 0.03, 0.30) and alcohol-related problems were reduced (d_+ = 0.14, 95% CI 0.06, 0.22) among intervention participants compared with controls. Results were parallel using fixed- or random-effects assumptions and all effects were homogeneous.

3.6 Moderators of Alcohol-Related Problems at Short-Term Follow-Up

Weighted least squares regression analyses were conducted to examine potential moderators of alcohol-related problems at short-term follow-up. We created indicator variables to represent sample characteristics (2: percent women; percent white), target group (2: heavy drinkers; and other at-risk group including Greeks, athletes, freshman, party attendees, and students turning 21), recruitment method (3: volunteered, recruited, mandated), intervention modality (2: individual, group), contact context (3: in-person, computer/mail, both), tailoring of the intervention (2: individual-level, group-level), control type (1: assessment-only vs. any comparison condition) and intervention content (13: See Table 1 for list of intervention components). Therefore, 28 separate univariate regression analyses were conducted; 12 were

[v]We further examined the weighted mean effect sizes separated by type of control condition (no-contact vs. any contact). The pattern of results was similar.

statistically significant. Interventions were *more* successful at reducing alcohol-related problems at short-term follow-up if the sample contained more women ($B = 0.56$, $p = 0.01$); interventions were delivered individually ($B = 0.28$, $p < .001$), or in-person ($B = 0.17$, $p = .01$); motivational interviewing techniques were used ($B = 0.21$, $p < .01$); and the intervention content contained normative feedback ($B = 0.17$, $p = .01$), feedback on expectancies and/or motives for drinking ($B = 0.27$, $p < .001$), or a decisional balance exercise ($B = 0.17$, $p = .05$). Interventions were *less* successful if they targeted heavy drinkers ($B = -0.34$, $p < .001$) or any other at-risk group ($B = -0.14$, $p = .05$), when the intervention was delivered via computer/mailing ($B = -0.22$, $p < .01$) and the intervention content included an expectancy challenge exercise ($B = -0.20$, $p < .01$) or skills-training ($B = -0.28$, $p < .001$).

4. Discussion

To our knowledge, this study provides the first meta-analytic integration of the results of randomized clinical trials designed to evaluation alcohol abuse prevention programs for college drinkers. A compelling benefit of meta-analysis is that it can provide a powerful method to test effects across many studies, each of which may not be adequately powered to detect intervention effects at standard conventions of significance. Meta-analysis also affords the opportunity to identify moderators when a set of effect sizes demonstrates heterogeneity. Our goals were to characterize the efficacy of interventions for college student drinkers across outcomes and follow-up intervals. Three major findings emerged: (a) individual-level alcohol interventions for college drinkers reduce alcohol use; (b) these interventions also reduce alcohol-related problems, and reductions in problems vary by sample and intervention characteristics; and (c) the contrast between students who receive interventions and those in control conditions diminishes over time. Each of these findings will be discussed in turn.

The primary finding of this meta-analysis is that students who received risk reduction interventions subsequently engaged in less extreme drinking behavior than students in control conditions. Significant effect sizes were observed across multiple measures of alcohol consumption, representing quantity frequency, and measures of intoxication, with d_+s ranging from 0.11 to 0.41. Conventionally, these effect sizes are in the range of small to medium (Cohen, 1988). Notably, a meta-analytic review of 62 meta-analyses with nearly 600 000 participants conducted across health areas revealed an average weighted mean effect size of 0.20 ($k = 13$) across addictions interventions (Johnson, Scott-Sheldon, & Carey, 2007). Thus, the magnitudes of the observed effects are consistent with those found in the broader addictions treatment literature. Our findings demonstrate clearly that alcohol risk reduction interventions of various forms reliably reduce quantity and frequency of drinking by college students.

A second and equally important finding is that alcohol risk reduction interventions succeed in reducing alcohol-related problems reported by college drinkers. Negative consequences of alcohol misuse for the drinker can occur across one or more functional domains (e.g., social, physical, academic, legal; Perkins, 2002). In addition, negative consequences such as drinking and driving, property damage, fights, and alcohol poisoning also have implications for other people and the institution. Thus, reductions in negative consequences not only benefit the drinker but also benefit others. Effect sizes for problems were $d_+ = 0.15$ (at short-term follow-up), peaking at $d_+ = 0.22$ (at intermediate follow-up), and $d_+ = 0.14$ (at long-term follow-up), maintaining significance into follow-ups lasting over six months. Effect sizes for alcohol-related problems tended to be homogenous with one exception; that is, at short-term follow-up we did observe heterogeneity among the effect sizes. We explored whether systematic variation across sample characteristics, and intervention components could explain variability within effect size estimates.

Several sample characteristics moderated alcohol-related problems at short-term follow-up. Interventions were more successful in reducing alcohol-related problems when more females were sampled. Female students generally experience fewer alcohol related problems than do male students (American College Health Association, 2007). More importantly, women may be less reliant on drinking situations and drinking "buddies" to meet their social needs (Borsari & Carey, 2006). Also, female students may be more willing to participate and respond to alcohol interventions compared with male students; research in community samples demonstrates that heavy drinking women respond more positively to brief interventions than do heavy drinking men (Sanchez-Craig, Spivak, & Davila, 1991).

Interventions were less successful in reducing problems (compared with controls) when they were targeted to heavy drinkers or other high risk groups. Such students are likely to have heavy drinking peers and be embedded in more alcohol-involved social networks (e.g., Reifman, Watson, & McCourt, 2006). Drinking in high risk groups may serve functions different than drinking in the general student population, requiring tailored interventions that address deep structure, such as core beliefs, values, and norms (Resnicow et al., 2000). Overall, these findings highlight the need to develop more efficacious interventions for heavy drinking students and those who belong to other at-risk groups such as Greeks and athletes.

Intervention characteristics also predicted variability in problems outcomes. Specifically, interventions delivered to individuals rather than groups, and interventions that used motivational interviewing, provided feedback on expectancies or motives, normative comparisons, and included decisional balance exercises were more successful at reducing alcohol-related problems than a range of comparison conditions. This set of components represents the core of brief motivational intervention packages, many modeled after the Brief Alcohol Screening and Intervention for College Students (BASICS) protocol developed by Dimeff, Baer, Kivlahan, and Marlatt (1999). In adult samples, brief motivational interventions for alcohol abuse using feedback produce small to medium effects when compared to no-treatment controls (Burke et al., 2003). Our findings provide indirect evidence of their efficacy with young adult drinkers. In contrast, interventions that included skills training or expectancy challenge components were less successful at reducing alcohol-related problems, relative to control interventions. These intervention components appeared relatively less frequent than others in the studies reviewed (23% and 16% respectively); however, it is unclear why they would predict less change in problems. It is worth noting that the presence of these intervention components was correlated with samples made up of heavy drinkers; thus, participant characteristics might explain the smaller intervention effects.

The third major finding is that effect size magnitude diminishes over time. The number of significant effect sizes peaked at the short-term (4-13 weeks) and intermediate term (14-26 weeks) follow-ups. Between-groups effects on consumption (quantity, heavy drinking frequency, and peak BAC) were observed immediately post-intervention, but few persist beyond 6 months (an exception is frequency of drinking days at long-term follow-up). In contrast, reduction in alcohol-related problems takes longer to emerge and continues into long-term follow-ups. This delayed response may be due to the lower base rate of problems relative to drinking occasions, even for heavier drinkers, requiring more time for reductions in problems to be noticed. The overall pattern suggests that interventions reduce consumption within one month, but between-groups differences cease to be significant after 6 months. It is worth noting that studies with large samples have reported reductions in drinking within assessment-only control conditions over periods of one to two years (e.g., Carey et al., 2006; Marlatt et al., 1998), perhaps reflecting naturally-occurring risk reduction associated with greater experience and maturity. Thus, one interpretation consistent with the observed reductions in effect size over time is that participation in an intervention prompts rapid risk reduction, but that controls "catch up" over time. Alternatively, initial risk reduction may deteriorate over time in

intervention conditions. Few studies analyzed their longitudinal outcome data in such a way as to describe trends over time (see Carey et al., 2006 for an exception). As a result, the observed pattern across studies may reflect either a deterioration of intervention effects or an improvement in control group behavior.

The primary limitation is that the numbers of studies available were too few to allow evaluation of some predictors. For example, few studies investigated some intervention components (e.g., computer-administered interventions, peer facilitators); thus, evaluation of their unique relationship to intervention effects was not possible. Similarly, the small number of studies could not support multivariate predictor models that would allow evaluation of independent contributions, or interactions among predictors. Thus, our predictor analyses should be considered preliminary, and an underestimate of the potential promise of some intervention components.

These findings have implications for college drinking interventions development. First, future interventions should be designed to evaluate maintenance of effects. The typical study in this sample of 62 reported only one follow-up; future studies should evaluate maintenance of intervention effects over periods of 6-12 months. Second, investigators should explore ways of enhancing the efficacy of interventions to achieve larger between-group effect sizes. More explicit consideration of the developmental context and functions of drinking among adolescents and young adults (US Department of Health and Human Services, 2007) will likely produce stronger effects. For example, given the social-affiliative function of drinking among college students, interventions that incorporate peers (e.g., Tevyaw et al., 2007) or pre-existing social groups (Larimer et al., 2001) warrant greater attention. Both efficacy and maintenance may be enhanced by supplementing individual-focused interventions with environmental changes. Multi-level interventions include coordinated media, law enforcement, and community initiatives (National Research Council and Institute of Medicine, 2004). Evaluation of multi-level intervention strategies may require partnership between researchers with individual- and population-level expertise. Third, the finding that student and intervention characteristics explain heterogeneity of effects on problems suggests two implications for research. One is the use of components analysis (Kazdin, 1994) to reveal additive or interactive effects of intervention components. Another is continued investigation of participant characteristics that might moderate intervention response.

In sum, providing interventions to reduce hazardous drinking by college students is clearly worthwhile. These results demonstrate that risk reduction interventions for college drinkers result in significantly less drinking over follow-up intervals lasting up to 6 months. The interventions summarized in this meta-analysis also averted alcohol-related problems over longer intervals. Moderator analyses suggest that individually-administered interventions, providing feedback and normative comparisons are most likely to reduce alcohol-related problems over time. Needed are more efficacious interventions for at-risk students, and interventions that promote maintenance of risk reduction.

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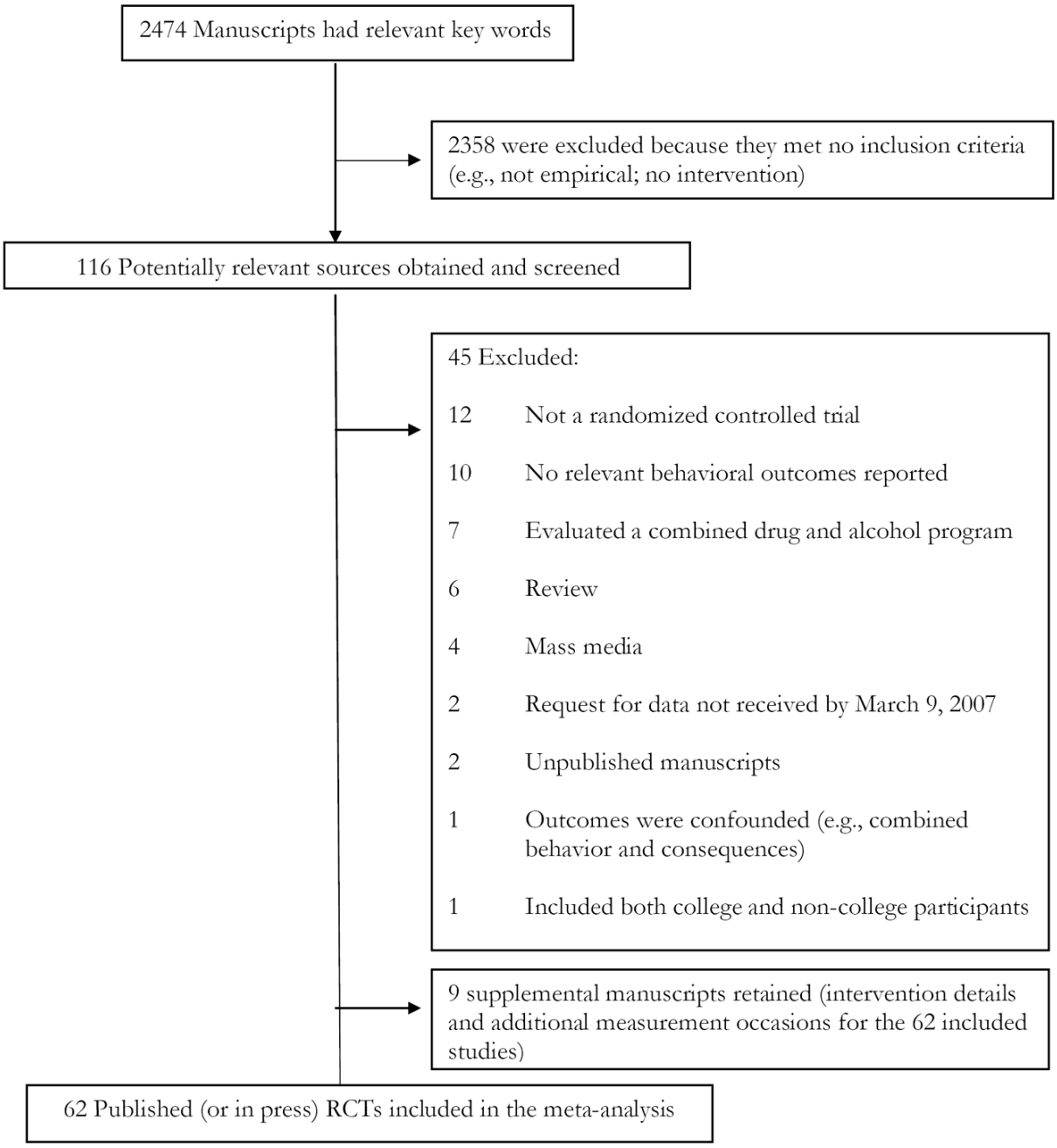

Figure 1.
Selection process for study inclusion in the meta-analysis.

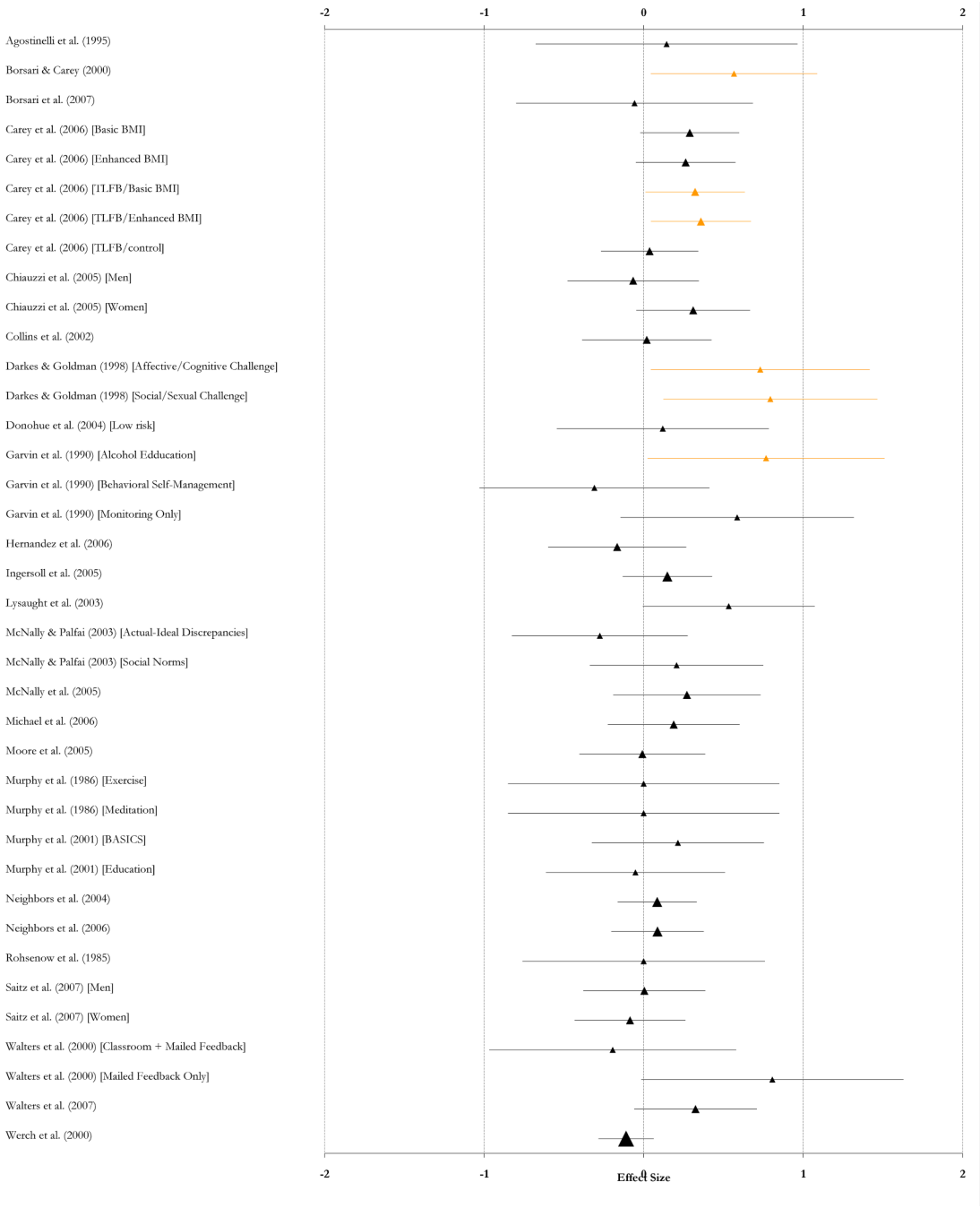

Figure 2.

Forest plot of the effect sizes and their 95% confidence intervals for quantity of alcohol consumed at short-term follow-up (k = 38). The size of the triangle representing each effect size is proportional to its weight in the analysis. Effect sizes significantly favoring the intervention groups appear in orange (none of the effect sizes significantly favored the control condition). *Note*: BMI, brief motivational interview; TLFB, time-line follow-back; BASICS, Brief Alcohol Screening and Intervention for College Students.

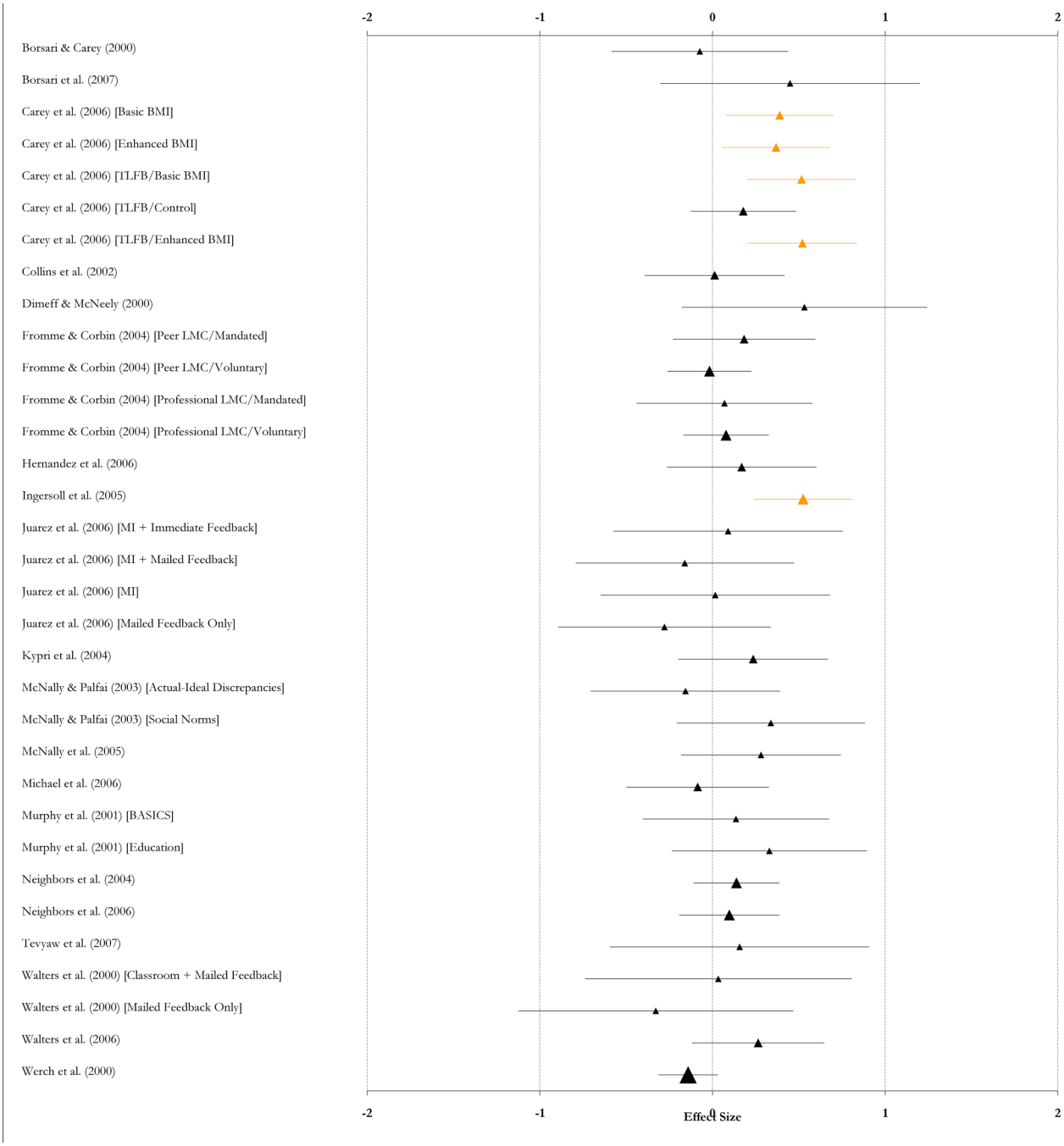

Figure 3.

Forest plot of the effect sizes and their 95% confidence intervals for alcohol-related problems at short-term follow-up (k = 33). The size of the triangle representing each effect size is proportional to its weight in the analysis. Effect sizes significantly favoring the intervention groups appear in orange (none of the effect sizes significantly favored the control conditions). *Note*: BMI, brief motivational interview; LMC, Lifestyle Management Class; MI, motivational interview; TLFB, time-line follow-back; BASICS, Brief Alcohol Screening and Intervention for College Students.

Table 1

Study, sample, and intervention characteristics of the 62 studies included in the meta-analysis.

Study	Location[a]	N[b]	Demographics[c]	Target	Recruit[d]	Theory[e]	Control[f]	Mode[g]	Intervention Components[h]	Contacts/ Total Minutes[i]
Agostinelli et al. (1995)	US-SW L public	23	F 48%; W 83%, B 4%, H 4%, A 4%	heavy drinkers	V	SRT	AO	P	AE, FC, FP, NC, M, MI	1/10
Baer et al. (1992)	US-NW L public	100	52% F; W 91%, A 5%, B 1%	heavy drinkers	V	CBT	BV	G	AE, FC, FE, EC, ST, MS, HR, GS, M, MI	6/540
Barnett et al. (1996)	US-NW L public	317	F 50%; W 100%	-	M	CDT, RGT, SDT	AO	G	*Peer Norms Education:* NC *Values Clarification*: VC *Peer Norms + Values Clarification:* NC, VC	1/45
Borsari & Carey (2000)	US-NE L private	59	F 57%; W 88%	heavy drinkers	V		AO	I	AE, FC, FP, NC, FE, DB, MS, HR, MI	1/60
Borsari & Carey (2005)	US-NE L private & S LAC	60	F 17%; W 92%	heavy drinkers	M	HR	RM	I	AE, FC, FP, NC, FE, HR, GS, MI	1/60
Borsari et al. (in press)	US-NE M private	28	F 33%; W 94%	alcohol offenders	M		AE	I	AE, FC, FP, NC, DB, MS, HR, GS, MI	2/68.5
Carey et al. (2006)	US-NE L private	496	F 65%; W 89%, A 5%, B 4%	heavy drinkers	V		AO	I	*TLFB/BMI Enhanced:* AE, FC, FP, NC, FE, DB, MS, HR, GS, MI *Enhanced BMI:* AE, FC, FP, NC, FE, DB, MS, HR, GS, MI *TLFB/Basic BMI:* AE, FC, FP, NC, FE, MS, HR, MI *Basic BMI:* AE, FC, FP, NC, FE, MS, HR, MI *TLFB/Control*	2/120 1/60 2/120 1/60 1/60
Chiauzzi et al. (2005)	US-NE 4 M/L private & public	215	F 54%; W 73%, A 11%, H 8%, B 3%	heavy drinkers	V		RM	C	AE, FC, FP, NC, MS, HR	4/80
Collins & Carey (2005)	US-NE L private	84	F 63%; W 92%	heavy drinkers	V	DMT	AO	I P	*In-Person Decisional Balance:* DB, GS, MI *Written Decisional Balance:* DB, GS, MI	1/30
Collins et al. (2002)	US-NE L private	94	F 50%; W 86%	heavy drinkers	V		AE	P	AE, FC, FP, NC, M	1/15
Corbin et al. (2001)	US-SE L public	62	F 50%	moderate to heavy drinkers	V		monitor-only	G	AE, FC, FE, ST	3/255
Cronin (1996)	US-SE S LAC	128	F 52%; W 100%	-	V	HR	AO	G	AE, HR, GS	1/15
Curtin et al. (2001)	SU-SE L public	74	F 100%; W 95%	female heavy drinkers	V	SCT, SRT	AO	I	*No Goal/Feedback:* AE, FC, FP, MS, M *Proximal Goal/ Feedback:*	2/60

Study	Location[a]	N[b]	Demographics[c]	Target	Recruit[d]	Theory[e]	Control[f]	Mode[g]	Intervention Components[h]	Contacts/ Total Minutes[i]
									AE, FC, MS, GS, M *Distal Goal/Feedback:* AE, FC, MS, GS, M *Proximal Goal/No Feedback:* AE, MS, GS *Distal Goal/No Feedback:* AE, MS, GS	
Darkes & Goldman (1993)	US-SE L-public	50	F 0%; W 95%, B 3%, H 3%	heavy drinking males	V	NNT	AO	G	*Expectancy Challenge:* AE, FE, EC *Traditional Information*: AE, MS	3/315
Darkes & Goldman (1998)	US-SE L-public	54	F 0%; W 87%, A 6%, H 6%, B 2%	heavy drinking Males	V	NNT	INM	G	*Social/sexual challenge:* FE, EC *Affective/cognitive challenge:* FE, EC	4/240
Dimeff & McNeely (2000)	US-NW L public	33	F 62%; W 74%, A 10%, B 2%	heavy drinkers	R		AO	C	AE, FC, FP, NC, MS, M	1/15
Donohue et al. (2004)	US-SW L public	104	F 56%; W 63%, A 13%, H 12%, B 8%	heavy drinkers	V	CBT	RNM	C	AE, NC, DB, ST, HR	1/45
Fromme & Corbin (2004)	US-SW L public	106	*Disciplinary Sample*: F 24%; W 75%, H 12%, A 7%, B 2%	heavy drinkers	M	CBT, SC	AO	G	*Peer Lifestyle Management Class:* AE, FC, FP, NC, ST, MS, GS, M, MI	2/240
		332	*Volunteer sample:* F 41%; W 59%, H 18%, A 17%, B 5%	-	V			G	*Professional Lifestyle Management Class*: AE, FC, FP, NC, ST, MS, GS, M, MI	
Garvin et al. (1990)	US-SE	60	F 0%	fraternity members	V		AO	G	*Behavior Self-Management:* AE, ST, MS	3/135
								G	*Alcohol Education:* AE	3/135
								I	*Monitoring Only*	0/0
Glindermann et al. (2007)	US-SE L public	366	F 32%	party attendee	V		AE	I	AE, MS, M	1/5
Hansson et al. (2006)	Sweden L public	78	F 72%	students with alcoholic parents	V	CBT	IM	I	*Alcohol Program:* AE, FC, NC, FE, MS, HR, GS *Alcohol + Coping Program:* AE, FC, NC, FE, MS, HR, GS	2/240
Hernandez et al. (2006)	US-SW; L public	86	F 40%; H 100%	drinkers	V	HR	BV	2	AE, FC, FP, NC, FE, ST, MS, HR, MI	1/120
Howat et al. (1991)	Australia L public	48	F 0%	heavy drinking males			AO	I	AE, EC, M	2/72

Study	Location[a]	N[b]	Demographics[c]	Target	Recruit[d]	Theory[e]	Control[f]	Mode[g]	Intervention Components[h]	Contacts/ Total Minutes[i]
Ingersoll et al. (2005)	US-SE; L public	199	F 100%; Ethnicity: 70% W, 16% B, 6% A, 2% H	heavy drinkers at risk for alcohol-exposed pregnancy	V		AE	I	FC, FP, DB, HR, GS, MI	1/67.5
Johnsson & Berglund (2003)	Sweden; L public	658	F 32%	pub patrons	V		AO	I	*Bartender Program*: AE, NC, FE, ST	5/720
Johnsson & Berglund (2006)	Sweden; L public	149	F 25%	heavy drinking freshman	V	CBT	BV	G	AE, FC, FP, NC, FE, EC, MS, HR, GS, MI	5/600
Jones et al. (1995)	US-SE; M private	90	F 46%; W 90%	drinkers	V	SLT	IM	G	*Expectancy Challenge:* AE, EC	2/120
									Expectancy Challenge + Inoculation: AE, FE, EC	2/120
Juarez et al. (2006)	US-SW; L public	89	F 53%; W 57%, H 30%	heavy drinkers	V		AO	I	*MI + Immediate Feedback:* AE, FC, FP, NC, FE, DB, GS, MI	1/105
								I	*MI*: AE, DB, GS, MI	1/50
								I + P	*MI + Mailed Feedback:* AE, FC, FP, NC, FE, DB, GS, M, MI	1/60
								P	*Mailed Feedback*: AE, FC, FP, NC, FE, M	0/10
Keillor et al. (1999)	US-SW; L public	25	F 0%	heavy drinking males	M		RM	G	FE, EC	2/180
Kivlahan et al. (1990)	US-NW; L public	36	F 42%; W 91%, B 5%, A 2%, H 2%	heavy drinkers	V	CBT, SLT	AO	G	*Cognitive-Behavioral Skills:* AE, FC, FP, EC, ST, MS, HR, GS *Alcohol Information:* AE	8/720
Kypri & McAnally (2005)	New Zealand; L public	126	F 51%; W 75%	-	R		AO	C	AE, FC	1/10
Kypri et al. (2004)	New Zealand; L public	94	F 50%; W 91%	heavy drinkers	R		AO	C	AE, FC, FP, NC, M, MI	1/7.8
Larimer et al. (2001)	US-NW; L public	120	F 0%; W 82%, A 13%, H 1%	freshman fraternity members	V	HBM, SM	AE	I + G	AE, FC, FP, NC, FE, DB, MS, GS	2/120
Lysaught et al. (2003)	US-NE; colleges	55	F 53%; W 78%, A 8%, B 7%, H 2%	-	V	SCT	AO	I	AE, FC, FP, M	1/10
Marlatt et al. (1998)	US-NW; L public	299	F 53%; W 85%, A 9%, H 3%, B 1%	freshman heavy drinkers	R		AO	I	AE, FC, FP, NC, FE, MS, M, MI	1/60
McNally & Palfai (2003)	US-NE; L private	76	F 65%; W 77%, A 8%,	heavy drinkers	V	CDT, SDT,	IM	G	*Actual-Ideal Discrepancies:*	1/40

Study	Location[a]	N[b]	Demographics[c]	Target	Recruit[d]	Theory[e]	Control[f]	Mode[g]	Intervention Components[h]	Contacts/ Total Minutes[i]
			H 5%, B 4%			SNT			DB, VC, MS, GS, MI *Social Norms:* AE, NC, MI	
McNally et al. (2005)	US-NE; private	73	F 71%; W 85%, A 8%, H 3%	heavy drinkers	V	CDT	IM	I	AE, FC, FP, NC, FE, DB, MS, GS, M, MI	1/30
Michael et al. (2006)	US-SE; L public	91	F 63%; W 94%, B 4%, A 1%, H 1%	freshman	V		AO	G	AE, NC, DB, VC, GS, MI	1 - 2/50 - 75
Moore et al. (2005)	US-SE; L public	106	F 58%; W 70%, H 10%, A 9%, B 8%	-	V	EPPM, HBM, SCT	RM	C	AE, FE, MS	4/60
Murgraff et al. (2006)	UK	347	F 70%	moderate drinkers	V	SCT, TPB	AO	P	AE, NC, MS, GS	1/10
Murgraff et al. (1996)	UK	102	F 74%	heavy drinkers	V	TE	BV	G	AE, MS, GS, M	1/15
J. G. Murphy et al. (2004)	US-SE; L public	51	F 69%; W 94%	heavy drinkers	V		RM	I	AE, FC, FP, NC, GS, M, MI	1/40
J. G. Murphy et al. (2001)	US-SE; L public	79	F 54%; W 94%	heavy drinkers	V	SCT	AO	I	*BASICS*: AE, FC, FP, NC, FE, VC, MS, GS, M, MI *Education*: AE, M	1/50
T. J. Murphy et al. (1986)	US-NW; L public	31	F 0%	heavy drinking males	V		AO	I + G	*Exercise* *Meditation*	24/1680 24/480
Musher-Eizenman & Kulick (2003)	US-MW; L public	54	F 100%; W 94%, B 4%, H 2%	moderate to heavy drinking females	V	SLT	RM	G	*Social/Sexual:* AE, FE, EC, M *Cognitive/Motor*: AE, FE, EC, M	3/315
Neal & Carey (2004)	US-NE; L private	92	F 55%; W 85%, A 5%, B 2%, H 2%	heavy drinkers	V	SRT	RM	G	*Feedback:* FC, FP, NC, M, MI *Personal Strivings Assessment:* GS, MI	1/40
Neighbors et al. (2004)	US-NW; L private	207	F 59%; W 80%, A 14%	heavy drinkers	V	SNT	AO	C	FC, NC, M	1/5
Neighbors et al. (2006)	US-MW; M private	185	F 56%; W 98%	heavy drinkers	V	SNT, SDT	AO	C	FC, NC, M	1/5
Neighbors et al. (2005)	US-MW; L public	164	F 59%; W 96%	students turning 21	R		AO	P	HR, M	1/5
Peeler et al. (2000)	US-NW; L public	157	F 62%; W 84%	-	V	SNT	IM	G	AE, NC, ST, HR	13/650
Rohsenow et al. (1985)	US-NW; L public	34	F 0%	heavy drinking males		CBT	AO	I + G	ST	6/360
Saitz et al. (2006)	US-NE; L private	235	F 55%; W 81%, A 11%, H 6%	heavy drinking freshman	R	SCA, SNT	AE	C	AE, FC, FP, NC, DB, MI	1/30
Smith et al. (2006)	US-SE; L public	444	*Cohort #1:* F 58%; W 72%, B 21%	students turning 21	R	HR, SNT	IM	P	*BRAD Card:* AE, MS, HR, M *Social Norm Card:* NC, M	1/5
		550	*Cohort #2:* F 56%;						*Information Card:* MS, M	

Study	Location[a]	N[b]	Demographics[c]	Target	Recruit[d]	Theory[e]	Control[f]	Mode[g]	Intervention Components[h]	Contacts/ Total Minutes[i]
			W 74%, B 19%						*Combination Card:* NC, MS, M	
Stahlbrandt et al. (2007)	Sweden; L public	371	F 36%	resident hall students	R	CBT	AO	G	*Brief Skills Training:* AE, FC, FP, NC, FE, HR, M, MI	2/190
						CBT	AO	G	*12-Step:* AE, FC, FP, NC, M, MI	
Stamper et al. (2004)	US-SE; L public	874	F 61%; W 75%, B 18%, A 3%, H 1%	freshman	V	SNT	BV	G	AE, FC, NC, FE, VC	1/60
Tevyaw et al. (2007)	US-NE; M private	28	F 34%; W 85%	alcohol offenders	R		RM	G	AE, FC, FP, NC, FE, DB, MS, GS, M, MI	1/90
Walters et al. (2000)	US-SW; L public	37	F 40%; W 62%, H 30%	heavy drinkers	V		AO	G + P	*Full Treatment* AE, FC, FP, NC, DB, VC, ST, MS, M, MI	2/130
								P	*Mailed Feedback:* AE, FC, FP, NC, M, MI	1/10
Walters et al. (in press)	US-SW; S & L public	82	F 48%; W 73%	heavy drinking freshman	V	SCT, SNT	AO	C	AE, FC, FP, NC, MI	1/12.5
Werch et al. (2000)	US-SE; L public	521	F 64%; W 83%, B 11%, H 3%	freshman	V	SNT	AO	P	AE, NC, HR, M	3/15
White et al. (2006)	US-NE; L private	319	F 40%; W 79%, A 16%, B 2%	alcohol offenders	M		BV	I	AE, FC, FP, NC, FE, MS, GS, M, MI	1/30

[a] Location refers to university location, including size and type (public, private, liberal arts college). US = United States; UK = United Kingdom; NE = Northeast; SE = Southeast; MW = Midwest; SE = Southeast; SW = Southwest; S = Small; M = Medium; L = Large; LAC = Liberal Arts College.

[b] *N* refers to the largest available *n* at a follow-up measurement occasion, not initial *N*.

[c] Demographics: F = female; A = Asian; B = Black; H = Hispanic/Latina; W = White.

[d] Recruitment method: V = volunteered; R = recruited; M = mandated.

[e] Stated theory used: CBT = Cognitive-Behavioral Theory; CDT = Cognitive-Dissonance Theory; DMT = decision-making theory; EPPM = Extended Parallel Processing Model; HBM = Health Belief Model; HR = harm-reduction; NNT = neural network theory; RGT = Reference Group Theory; SC = Stages of Change; SCA = self-change approach; SCT = Social-Cognitive Theory; SD = Self-Determination Theory; SDT = Self-Discrepancy Theory; SLT = Social Learning Theory; SM = self-monitoring; SNT = Social Normative Theory; SOC = Stages of Change; SRT = Self Regulation Theory; TE = theories of enactment; TPB = Theory of Planned Behavior.

[f] Type of control/comparisons condition: AO = assessment-only; AE = alcohol-education; BV = brief version of intervention; IM = irrelevant content, time-matched; INM = irrelevant content; not time-matched; RM = relevant content, time-matched.

[g] Mode of intervention delivery: C = computer/internet; G = group; I = individual; P = print.

[h] Intervention components: AE = alcohol education; DB = decisional balance; EC = expectancy challenge; FC = feedback on consumption; FE = feedback on expectancies and/or motives; FP = feedback on problems; GS = goal-setting; HR = identification of high-risk situations; M = provided materials; MI = motivational interviewing; MS = moderation strategies; NC = normative comparisons; ST = skills-training; VC = values clarification.

[i] Estimated dosage excluding measurement.

Table 2

Effect sizes and homogeneity statistics for college drinking interventions vs. controls, over four follow-up intervals.

Outcome	*k* of interventions	Weighed mean *d* (and 95% confidence interval)		Homogeneity of effect sizes		Variation due to heterogeneity I^2 index (and 95% uncertainty interval)
		Fixed effects	Random effects	*Q*	*P*	
Immediate Posttest (≤ 3 weeks)						
Quantity	18	0.19 (0.07, 0.32)	0.20 (0.06, 0.33)	20.53	.36	9% (0%, 45%)
Quantity, specific intervals/drinking days[a]	19	0.03 (-0.05, 0.11)	0.03 (-0.05, 0.11)	13.92	.73	0%
Maximum quantity	6	0.05 (-0.12, 0.23)	0.04 (-0.19, 0.28)	8.96	.11	44% (0%, 78%)
Frequency of heavy drinking[a]	13	0.17 (0.03, 0.31)	0.18 (0.02, 0.35)	15.04	.24	20% (0%, 58%)
Frequency of drinking days[a]	5	-0.08 (-0.26, 0.10)	-0.08 (-0.26, 0.10)	3.14	.53	0%
Peak BAC	5	0.41 (0.26, 0.57)	0.36 (0.03, 0.69)	11.66	.02	66% (10%, 87%)
Problems	9	0.02 (-0.08, 0.12)	0.02 (-0.08, 0.13)	8.91	.35	21% (0%, 64%)
Short-term Follow-up (4 – 13 weeks)						
Quantity[a]	38	0.13 (0.06, 0.19)	0.14 (0.07, 0.22)	44.98	.17	18% (0%, 45%)
Quality, specific intervals/drinking days	22	0.13 (0.05, 0.21)	0.15 (0.06, 0.21)	23.17	.33	9% (0%, 44%)
Maximum quantity	8	0.08 (-0.04, 0.20)	0.07 (-0.07, 0.21)	8.74	.27	20% (0%, 62%)
Frequency of heavy drinking[a]	27	0.18 (0.10, 0.26)	0.21 (0.12, 0.30)	31.03	.23	16% (0%, 48%)
Frequency of drinking days	13	0.02 (-0.07, 0.10)	0.08 (-0.06, 0.22)	19.68	.07	39% (0%, 68%)
Peak BAC[a]	15	0.13 (0.04, 0.21)	0.13 (0.04, 0.21)	7.36	.92	0%
Composite alcohol consumption	10	0.03 (-0.07, 0.12)	0.04 (-0.10, 0.18)	16.72	.06	46% (0%, 74%)
Problems	33	0.15 (0.08, 0.21)	0.16 (0.08, 0.25)	46.31	.05	31% (0%, 55%)
Intermediate Follow-up (14 – 26 weeks)						
Quantity[a]	19	0.11 (0.02, 0.20)	0.11 (0.02, 0.20)	14.60	.69	0%
Quantity, specific intervals/drinking days	8	0.19 (0.08, 0.31)	0.20 (0.06, 0.34)	10.02	.19	30% (0%, 69%)
Frequency of heavy drinking	12	0.11 (0.01, 0.22)	0.11 (0.01, 0.22)	11.08	.44	1% (0%, 11%)
Frequency of drinking days	5	-0.03 (-0.16, 0.10)	-0.03 (-0.16, 0.10)	0.25	.99	0%
Peak BAC	12	0.10 (-0.01, 0.20)	0.11 (-0.01, 0.22)	11.93	.37	8% (0%, 46%)
Composite alcohol consumption	5	0.06 (-0.08, 0.19)	0.06 (-0.08, 0.19)	0.92	.92	0%
Problems	12	0.22 (0.12, 0.32)	0.22 (0.12, 0.32)	8.04	.71	0%
Long-term Follow-up (27 – 195 weeks)						
Quantity[a]	14	0.06 (-0.04, 0.16)	0.06 (-0.04, 0.16)	8.32	.74	0%
Quantity, specific intervals/drinking days	7	0.07 (-0.05, 0.19)	0.07 (-0.05, 0.19)	3.99	.68	0%
Frequency of heavy drinking	8	-0.04 (-0.16, 0.08)	-0.04 (-0.16, 0.08)	6.98	.44	0%
Frequency of drinking days	5	0.16 (0.03, 0.30)	0.16 (0.03, 0.30)	3.06	.55	0%
Peak BAC	10	0.09 (-0.02, 0.20)	0.09 (-0.02, 0.20)	10.53	.31	15% (0%, 56%)
Typical BAC	5	-0.01 (-0.16, 0.14)	-0.01 (-0.16, 0.14)	3.50	.48	0%
Composite alcohol consumption[a]	5	0.11 (-0.05, 0.27)	0.11 (-0.05, 0.27)	1.00	.91	0%
Problems[a]	16	0.14 (0.06, 0.22)	0.12 (0.01, 0.23)	24.19	.06	38% (0%, 66%)

Note. BAC = blood alcohol concentration

[a]Outliers were excluded.