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Drinking Norms and College Student Alcohol Outcomes: Systematic Review and Meta-Analysis

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by

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ABSTRACT

Despite efforts to reduce problematic alcohol use on college campuses, students continue to drink heavily and experience alcohol-related consequences (e.g., Hingson, Zha, & Smyth, 2017.) Descriptive/injunctive norms positively relate to college students' own alcohol use. Despite substantial research, there have been few efforts to statistically synthesize these data. The present study was a correlation-based, random-effects meta-analysis. Articles published on drinking norms and alcohol outcomes published in English-language peer-reviewed journals between 2003 and 2015 were identified, coded, and subjected to meta-analytic integration. There was an overall medium, positive association found between descriptive norms and college student alcohol behaviors (r_w = 0.36). A relatively weaker small positive association was found between injunctive norms and college student alcohol behaviors (r_w = 0.18). Analyses revealed little evidence of publication bias. This research suggests that drinking norms are a viable target for college student drinking interventions. Future analyses should consider moderators of the relationships between norms and alcohol outcomes to optimize targeted interventions.

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Introduction

College Student Drinking

Research on college student alcohol use represents a substantial portion of national research expenditure. In 2017 alone, over 10 million dollars were awarded by the National Institute on Alcohol Abuse and Alcoholism (NIAAA) to study the etiology and treatment of drinking and associated problems among college students (NIH RePORTER, 2017). Despite this sizeable investment, heavy drinking on college campuses remains problematic. In 2016, 63.2% of college students endorsed past-month alcohol use, and 40.8% reported having been drunk in the past month (Schulenberg et al., 2017). Although fewer college students reported binge drinking or alcohol-impaired driving in 2014 compared to 1998, alcohol-related overdose deaths increased 254% per 100,000 students (Hingson, Zha, & Smyth, 2017), suggesting that college drinking remains a significant problem. College students who engage in heavy drinking experience a range of negative consequences, including driving after drinking, poor school performance, psychological distress, and increased risk for sexual assault (see Mallett et al., 2013 for a review). Evidence suggests that systematic analysis of the mechanisms influencing college student drinking is warranted to help develop and tailor more effective interventions.

Social Norms Theory and College Student Drinking

Given the negative consequences experienced by many college student drinkers, researchers have extensively studied the etiology of college alcohol use. Social Norms Theory offers one explanation for the incidence of heavy drinking on college campuses. Two types of social norms are commonly studied. The first, descriptive norms, refers to

college students' estimations of the typical quantity and frequency of alcohol consumption by their peers (Berkowitz, 2005). The second, injunctive norms, refers to college students' perceptions of the extent to which their peers approve of drinking and related behaviors (e.g., driving after drinking, "passing out" from drinking). Research on the relationship between drinking norms and college student alcohol use has yielded several consistent findings. College students report inflated descriptive and injunctive drinking norms, believing that the typical college student drinks more and is more approving of alcohol compared to their own drinking and associated beliefs. Elevated drinking norms have been evidenced in college student samples in the United States and in other countries (e.g., Lewis & Neighbors, 2004; McAlaney et al., 2012.)

To date, one meta-analysis has examined the extent to which students make systematic overestimations of campus drinking norms. Borsari and Carey (2003) calculated Fisher's *z* effect sizes across 23 studies to determine the magnitude of the difference between college students' descriptive and injunctive drinking norms and students' own self-reported alcohol use. The authors found a positive self-other discrepancy corresponding to a medium effect size (z_{Fisher} = .34), providing evidence for the existence of consistent overestimations of campus drinking norms. Borsari and Carey also examined moderators of the magnitude of descriptive and injunctive normative misperceptions, including type of norm, gender, reference group, specificity of question asked in study assessment, and campus size.

Proximity of the normative reference group is a commonly examined moderator. When students are asked to estimate the alcohol consumption of the "typical university student" (i.e. descriptive drinking norms) the magnitude of the correlation between

descriptive norms and student drinking is smaller (e.g., r = .40; Cho, 2006) than when students' close friends are used as the normative reference group (e.g., r = .70; Carey, Borsari, Carey, & Maisto, 2006). Proximity of the reference group also plays a role in moderating the relationship between injunctive drinking norms and college student alcohol use. Several studies have found that the direction of the relationship between injunctive norms and student drinking actually becomes *negative* when the "typical university student" is used as a reference group (e.g. Neighbors et al., 2008). From these examples, it is clear that the role of proximity of the reference group as a moderator of the relationship between drinking norms and college student alcohol behaviors warrants further systematic investigation.

Another commonly examined moderator is gender. Seminal research suggests that young women in college feel less comfortable with alcohol use than their male counterparts. Furthermore, when young women perceive a discrepancy between their own views on drinking and the social norm, they are more likely to feel alienated from their peers (Prentice & Miller, 1993). Research also suggests that same-sex descriptive drinking norms are more strongly related to personal drinking for women than for men (Lewis & Neighbors, 2004). Meta-regression is a systematic approach to examine whether gender moderates the strength of the associations between descriptive/injunctive drinking norms and alcohol outcomes across individual studies.

Borsari and Carey's (2003) seminal meta-analysis accomplished the goal of demonstrating the magnitude of discrepancy between college drinking norms and students' own alcohol use and related beliefs, providing a strong foundation for future research in this area. However, Borsari and Carey's meta-analysis was difference-based

rather than correlation-based. Results using this methodology cannot be used to draw conclusions regarding other aspects of the social norms model. Beyond asserting that students overestimate descriptive and injunctive drinking norms, the social norms approach states that elevated peer drinking norms are associated with higher self-reported drinking among college students. Efforts to synthesize research on this second assertion of the social norms model (i.e. the association between drinking norms and alcohol outcomes) have thus far been limited to narrative review (e.g., Borsari & Carey, 2001; McAlaney, Hughes, & Bewick, 2011; Monk & Heim, 2014.)

The Need for Meta-Analysis within the Drinking Norms Literature

The need for a methodological synthesis of the extant literature concerning drinking norms and college student alcohol use is clear. First, although narrative reviews have consistently concluded that the association between descriptive drinking norms and college student alcohol use is positive, estimates of the magnitude of this association vary widely by individual study. For example, Terlecki, Buckner, Larimer, and Copeland (2012) reported a correlation of $r = .06$ between descriptive drinking norms and alcohol use, Neighbors et al. (2008) found a much stronger relationship ($r = .41$), and Lee, Geisner, Lewis, Neighbors, and Larimer (2007) reported that the association between descriptive norms and alcohol use was stronger still ($r = .67$.) Narrative reviews cannot resolve the question of whether such differences in estimates reflect only sampling error or the presence of moderator variables. Finally, the rapid rate of publication of drinking norms research with college student populations suggests that integration of existing findings is warranted before further research expenditures are made. The extensive dissemination of research findings has rendered it difficult for researchers in the college

drinking norms field to make informed decisions as to the most promising directions of future research in this area. Meta-analytic integration will serve to indicate such areas of interest.

Study Aims

This study was a correlation-based random-effects meta-analysis of the relationships between descriptive and injunctive drinking norms and college student alcohol outcomes. Data from peer-reviewed articles published in English-language journals from 2003 to 2015 were coded and subjected to gold-standard meta-analytic procedures (e.g., Borenstein, Hedges, Higgins, & Rothstein, 2009; Liberati et al., 2009). Special attention was focused on well-documented methodological considerations that threaten the reliability and validity of published meta-analyses, including, calculation of inter-rater reliability and the file drawer problem (i.e. publication bias; Rosenthal, 1979). The primary aim of the study was to calculate two aggregate effect size estimations, one of the mean of the distribution of individual-study associations between descriptive drinking norms and college student alcohol outcomes, and one between injunctive drinking norms and college student alcohol outcomes. A secondary goal was to determine the relative homogeneity vs. heterogeneity of obtained correlations to inform future examinations of moderator variables.

Chapter 2: Method

Study Design

Overall framework. Current best practice recommendations for the reporting of meta-analyses are outlined through the Preferred Reporting Items for Systematic Reviews and Meta-Analyses framework (PRISMA; Liberati et al., 2009). PRISMA criteria were

developed through international collaborative efforts and include recommendations such as clear definition of eligibility criteria, full reporting of study selection and coding processes, and assessment of risk of bias within and between studies. PRISMA criteria were used to guide all implementation processes (e.g., study selection, coding, reporting of results).

Article Selection, Coder Training, and Article Coding

Article inclusion criteria. To be eligible for inclusion, articles must have had been published in English-language peer-reviewed journals between 2003 and 2015. 2003 was selected as the beginning year for inclusion to follow Borsari and Carey's (2003) meta-analysis on drinking norms. Articles were required to provide baseline data on the correlation between either descriptive or injunctive drinking norms and college student alcohol outcomes, or sufficient data to calculate effect sizes. Articles evaluating college student drinking interventions were eligible for inclusion if baseline data were available. Unpublished dissertations, published abstracts for poster presentations or symposia, book chapters, and other non-peer-reviewed reports were excluded. Given that the college environment is unique from other contexts (e.g., work), non-college samples of young adults were excluded.

Identification of articles. Identification of articles included: (1) keyword search of peer-reviewed articles in three databases: PsycINFO, Pubmed, and Google Scholar, (2) ancestry (i.e. utilizing citations from recent articles to locate earlier articles) and descendancy (i.e., searching forward from a key early study in citation indices to locate recent articles) searches, and (4) communication with alcohol norms senior investigators

to identify additional articles. A Boolean search strategy with the following terms was used: (norm*) AND (alcohol OR drink*) AND (college OR university OR student).

Storage of articles. Articles were stored both in an electronic database and in filed hard copy. Articles that were not readily obtained through the three databases were requested through the University of New Mexico's inter-library loan system. Article coding sheets were stored as hard copies to facilitate discussion and resolution of coding discrepancies.

Article coding form. A coding form was used to extract relevant information for the calculation of effect sizes from each article. The coding form included sections for information on sample characteristics; measurement of descriptive and injunctive alcohol norms and alcohol variables (11 items); study design features (16 items); and statistical analyses (3 items). Several iterations of the coding form were developed until a final form was approved by the team.

Coder selection. Four undergraduate students (AL, PM, AH, and RB) were selected through an interview process to contribute to the study as article coders. Desirable qualifications for undergraduate coders were a strong quantitative background, upperclassmen status, an interest in pursuing graduate education in psychology, and an interest in alcohol research. Despite a requirement of a one-year commitment to the project, coder turnover did occur, with two of the four coders dropping out of the project prior to its completion. Fortunately, coder turnover did not affect the article coding process. One coder dropped out of the project prior to the initiation of article coding (AL), and the second coder who dropped out left the project approximately two months

before article coding was complete (PM). Thus, AH and RB, along with the principal investigator, completed the majority of article coding.

Coder training. Each of three undergraduate coders who participated in article coding underwent an extensive training process to ensure competency in coding, including weekly coding meetings. Coders were initially required to read and discuss articles and book chapters on meta-analysis. They received training on how to fill out the article coding sheet, including group discussion of the definition of each code. From this discussion, a coding manual was developed to guide coding. The manual was revised as necessary through consensus throughout the coding process. After the final coding manual was approved, ten randomly selected articles were coded together by the coding team. The coding team discussed and resolved discrepancies by consensus.

Reliability. Formal inter-rater reliability was assessed twice during the coding process. Krippendorff's alpha (α; Hayes & Krippendorff, 2007) was calculated both for the overall agreement between the four coders, and between each coder individually paired with the principal investigator, designated as the coding "gold standard". Krippendorff's alpha values range from 0.00 to 1.00, with higher values indicating greater reliability between coders. Two additional efforts were made to promote coding reliability. To prevent coder drift, one article was coded together by all coders each month during the coding process (k = 5). In addition, 10% of all articles (k = 25) were double-coded by one of the three undergraduate coders, with discrepancies resolved through discussion with the principal investigator.

Effect Size Coding

Calculation of Effect Sizes. Because the proposed meta-analysis sought to quantify both the magnitude of the associations between drinking norms and college student alcohol outcomes, weighted Pearson's *r* was used as the index of effect size. Use of *r* has several benefits, including intuitive interpretation. One limitation to aggregate examination of *r* values is that the *r* distribution becomes skewed as values move further from 0. To address this issue, Fisher's transformation of *r* into *z* was applied prior to statistical analysis (Borenstein et al., 2009), and then the effect sizes were transformed back to *r*. In several cases, data were transformed in Comprehensive Meta-Analysis to yield effect size estimates (e.g., odds ratios, *t*-values).

Effect Size Calculations from Individual Studies. Studies varied widely in the number of effect sizes reported. On average, each study yielded 4.19 effect size estimates (*SD* = 4.69; Range = 1 to 30). Most often, multiple effect sizes per study occurred because associations of interest were reported for multiple reference groups (e.g., "typical university student" and "best friends") and alcohol outcomes (e.g., drinks per week and consequences). To minimize the risk of artificially deflated variance for the overall effect size estimates, effect sizes within each individual study were averaged separately for descriptive and injunctive norms, so that each study contributed only one effect size to each of the two meta-analyses. This procedure is consistent with the approach used in previous meta-analyses in this area (e.g., Rivis & Sheeran, 2003).

Statistical Analyses

Analysis of Primary Aims. Analyses were done using Comprehensive Meta-Analysis (CMA) software (version 2.0; Borenstein et al., 2009). CMA uses a hierarchical linear modeling (HLM) approach applied to meta-analysis (Raudenbush & Bryk, 2002).

Based on large sample theory, an effect size is approximately normally distributed with a sampling variance that can be estimated. For planned analyses, effect sizes were inversely weighted by their respective sampling variance such that effect sizes with less sampling error (i.e., larger sample size) were weighted more heavily than effect sizes from smaller samples with more sampling error. We used the formula, $V_j = 1/(n_j - 3)$, to compute the sampling variance of each Z_r. The mixed model approach was used to model between-study variability.

Distributional characteristics of effect sizes for each meta-analysis were separately examined to identify outlier values. The primary aim of the study was to separately summarize the overall weighted associations between descriptive/injunctive norms and alcohol outcomes among college students. This aim was achieved by using an "intercept only" model, $Zr_j = Y_0 + u_j + e_j$, to determine if the associations were significantly different from 0 and, if so, if sampling error fully explained the variability in the between-study effect sizes (u_j). If the random effect u_j is non-significant via the chi-square statistic, then sampling error fully accounts for the different effects sizes computed from the studies, giving confidence that the estimated mean effect size is stable.

Testing for the presence of publication bias was conducted. Several tests were used to assess for the presence of publication bias including inspection of funnel plots, Begg and Mazumdar's rank correlation, Orwin's Fail-Safe N, and Duval and Tweedie's trim and fill procedure. A funnel plot is a visual depiction of study sample size as a function of effect size. In the absence of publication bias, studies will appear to be symmetrically distributed across effect sizes. Begg and Mazumdar's rank correlation test

examines whether there is a significant correlation between standardized effect sizes and the variance of these effects (i.e., the precision of the estimate.) A statistically significant Begg and Mazumdar's rank correlation suggests the presence of publication bias, such that smaller studies are more likely to have larger effect sizes. Orwin's fail-safe N identifies how many missing studies of a given insignificant effect size, determined by the investigator, would need to be added to the meta-analysis for the combined effect size to be considered insignificant, also set by the investigator. Finally, Duval and Tweedie's trim and fill procedure expands upon inspection of the funnel plot by systematically removing the studies with the smallest sample size/largest effect size until the funnel plot becomes symmetrical (Borenstein, Hedges, Higgins, & Rothstein, 2009).

Chapter 3: Results

Coding Reliability

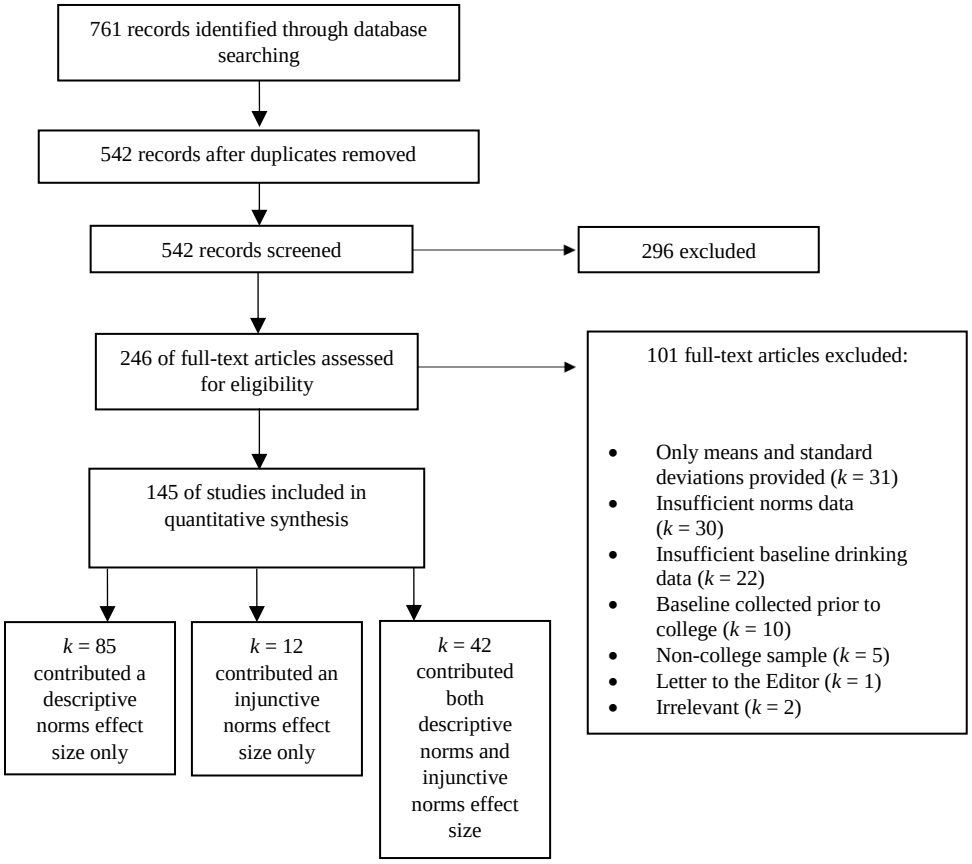
Following group coding of the ten initial articles, each coder was assigned five articles to code independently. Across the five studies, 580 data points from each coder (116 from each article) were used in the reliability calculations. Overall nominal Krippendorff's alpha across the four coders was 0.86. When each undergraduate coder was separately compared to the principal investigator, nominal Krippendorff's alpha values were 0.86, 0.90, and 0.91.

To improve reliability, the undergraduate coders received further training on coding with the principal investigator. The reliability exercise was repeated with five additional randomly selected articles. Overall Krippendorff's alpha across the four coders (PM, AH, RB, and KH) was 0.88. Reliability values for each of the three undergraduate coders separately compared to the principal investigator were 0.87, 0.90, and 0.91.

Descriptive Characteristics

A total of 145 articles (19.1% of articles initially identified) met inclusion criteria and were included in the final meta-analytic synthesis. Figure 1 illustrates the flow of article selection from initial identification to final retention.

Figure 1. *Flow of article identification and selection for meta-analytic review.*



Most articles were published in alcohol- or drug-focused specialty journals (*k* = 93, 64.1%), including Addictive Behaviors (*k* = 26); Journal of Studies on Alcohol or Journal of Studies on Alcohol and Drugs (*k* = 24); and Psychology of Addictive Behaviors (*k* = 19). Eighty-three articles (57.2%) specified a funding source. Of these, 65 reported receiving funding from NIH (78.3%; *k* = 60 from NIAAA; *k* = 5 from NIDA).

NIAAA Grant R01AA014576 (PI: Neighbors) was associated with the highest number of NIAAA-funded included articles (*k* = 16).

Most studies were conducted in the United States (*k* = 123), with the most common regions identified as Pacific (*k* = 40), Northeast (*k* = 27), and Southeast (*k* = 21). Seventeen studies were conducted in countries other than the United States. Studies were most commonly conducted on large campuses (*k* = 79), followed by medium (*k* = 47), and small (*k* = 6). Studies were generally conducted at four-year (*k* = 130), public universities (*k* = 94). Additional study design characteristics are presented in Table 1.

Table 1. *Study-level characteristics from articles included in meta-analytic review.*

Study Characteristics	*k*, %
Recruitment Pool (k = 140)	
Campus-Wide	54 (38.6%)
Greek organizations	3 (2.1%)
Psychology pool	31 (22.1%)
Incoming freshmen	9 (6.4%)
Other pool	46 (32.9%)
Number of Sites (*k = 145)*	
One site	111 (76.6%)
Multiple sites	34 (23.4%)
Data Collection (k = 138)	
Online or mailed survey	78 (56.5%)
In-person	60 (41.4%)
Study Type (k = 143)	
Non-Intervention	120 (83.9%)
Intervention	23 (16.1%)

The 145 articles included a total of 163,796 participants. The number of participants per study varied widely, ranging from 52 to 12,109 (*M* = 1,129.62, *SD* = 1,967.71, Median = 471). Some participants were not unique to each article, given that multiple publications resulted from the same dataset. However, due to lack of clear reporting on data sources across articles, the exact number of participants shared between

articles is not known. Across all studies, participants averaged 20.13 (*SD* = 1.78) years of age. Only 38 studies (26.2%) reported Greek organization membership, and 18 identified student-athletes (12.4%). Approximately 7.1% of all participants were identified as members of Greek organizations (*n* = 11,566) and 4.7% were identified as student-athletes (*n* = 7,681). Based on the 33 studies reporting on student residence, 13.5% of participants resided in on-campus housing (*n* = 22,193). Further study-level participant characteristics and measurement instruments are presented in Table 2.

Table 2. *Study participant and measurement characteristics from articles included in meta-analytic review.*

Study Authors	Pub.Yr.	% Male (*n*)	% NHW (*n*)	Type of Norms	Norms Measures	Normative Reference Groups	Alcohol Variables
Antin, Lipperman-Kreda, Paschall, Marzell, & Battle	2014	39.32% (2,298)	93.26% (5,451)	Descriptive; Injunctive	Authors wrote own questions	Best friends	Past-month Q/F; DPDD
Arbour-Nicitopoulos, Kwan, Lowe, Taman, & Faulkner	2010	39.98% (481)	60.02% (722)	Descriptive	Authors wrote own questions	Typical student	Any past-month drinking
Arterberry, Smith, Martens, Cadigan, & Murphy	2014	34.71% (126)	89.53% (325)	Descriptive	DNRF	Same-sex student at university; Same-sex student nationwide	DPW; DPDD; RAPI
Bartholow, Sher, & Krull	2003	42.14% (134)	N/R	Descriptive	Authors wrote own questions	Best friends	Heavy drinking composite
Benton, Downey, Glider, Benton, Shin, … Price	2006	45.79% (3,464)	88.33% (6,682)	Descriptive	College Alcohol Survey (CAS)	Typical student	DPDD; CAS alcohol problems scale
Bokeloo, Bush, & Novik	2009	40.47% (206)	61.30% (312)	Descriptive; Injunctive	Campus Alcohol Norms; Wing Accepta-bility Scale	Typical student; Same-sex student	Any past-month drinking
Boyd, Corbin, & Fromme	2014	38.56% (642)	60.90% (1,014)	Descriptive	DNRF	Best friends	DPW; Binge frequency; Drinking to intoxication
Boyle & Bokeloo	2009	35.09% (93)	69.06% (183)	Descriptive; Injunctive	Authors wrote own questions	Parents	AUDIT; YAAPST
Table 2 (cont.)							
Brechting & Carlson	2015	37.54% (125)	89.19% (297)	Descriptive	DNRF	Typical student; Same-age student; Best friends; Sorority member; Fraternity member	Q/F; DrInC
Broadwater, Curtin, Martz, & Zrull	2006	40.94% (70)	98.25% (168)	Descriptive	DNRF	Best friends	DPW
Burger, LaSalvia, Hendricks, Mehdipour, & Neudeck	2011	40.54% (45)	N/R	Descriptive	Authors wrote own questions	Typical student; Best friends	DPDD
Cail & LaBrie	2010	39.01% (1,464)	57.39% (2,154)	Descriptive; Injunctive	DNRF; INQ	Same-sex student; Typical student; Best friends; Parents	DPW; RAPI
Cameron & Campo	2006	47.07% (185)	7.89% (31)	Descriptive; Injunctive	Authors wrote own questions	Typical student	DPW; Binge frequency
Campo, Brossard, Frazer, Maschell, Lewis, & Talbot	2003	47.09% (259)	69.45% (382)	Descriptive	Authors wrote own questions	Male friends; Female friends	Drinking composite
Carcioppolo & Jensen	2012	51.10% (116)	N/R	Descriptive; Injunctive	N/R	Typical student; Best friends	Drinking composite

Table 2 (cont.)

Carey, Borsari, Carey, & Maisto	2006	36.00% (580)	81.01% (1,305)	Descriptive; Injunctive	DNRF; Perkins & Berkowitz (1986)	Same-sex student; Best friends; Typical student	DPW; RAPI
Caudwell & Hagger	2015	32.87% (94)	79.37% (227)	Injunctive	Authors wrote own questions	Important people	DPW
Champion, Lewis, & Meyers	2015	39.22% (111)	45.58% (129)	Descriptive	DNRF	Typical student; Same-sex student; Same Greek-status student	AUDIT
Chauvin	2012	36.00% (3,925)	74.00% (8,069)	Injunctive	Authors wrote own questions	Typical student	Any binging in past two weeks
Chawla, Neighbors, Lewis, Lee, & Larimer	2007	39.43% (552)	61.00% (854)	Injunctive	INQ	Typical student; Best friends	DPW
Chawla, Neighbors, Logan, Lewis, & Fossos	2009	42.05% (344)	65.16% (533)	Injunctive	INQ	Best friends; Parents	DPW
Cho	2006	36.12% (220)	84.07% (512)	Descriptive; Injunctive	Authors wrote own questions	Typical student; Best friends	DPDD
Cicognani & Zani	2011	27.04% (159)	0.00% (0)	Descriptive	Authors wrote own questions	Peer group	Past-month frequency
Cooke, Sniehotta, & Schuz	2007	42.13% (75)	N/R	Descriptive; Injunctive	Authors wrote own questions	Same-sex student; Important people	Binge frequency
Corbin, Iwamoto, & Fromme	2011	40.09% (900)	53.9% (1,210)	Descriptive	DNRF	Best friends	RAPI; binge frequency
Cox & Bates	2011	36.6% (214)	93.0% (544)	Descriptive; Injunctive	Campus Alcohol Norms Survey	Typical student (who drinks); Best friends	DPDD
Crawford & Novak	2010	N/R	N/R	Descriptive; Injunctive	Authors wrote own questions	Same-sex student; Best friends	Drinking composite
Cross, Zimmerman, & O'Grady	2009	28.0% (123)	84.6% (372)	Descriptive	Authors wrote own questions	Best friends	DPW
Cullum, Armeli, & Tennen	2010	50.1% (288)	86.1% (494)	Descriptive	Authors wrote own questions	Same-sex student; Best friends; Social group; Others you drink with	Drinking composite
Cullum, O'Grady, Armeli, & Tennen	2012	44.1% (175)	85.9% (341)	Descriptive	Authors wrote own questions	Others you drink with	DPDD
Cullum, O'Grady, Sandoval, Armeli, & Tennen	2013	52.0% (298)	86.1% (494)	Descriptive	Authors wrote own questions	Same-sex student	DPDD; Past-month frequency
Dams-O'Connor, Martin, & Martens	2007	65.8% (150)	75.0% (171)	Descriptive	DNRF	Typical student; Best friend; Typical athlete; Typical non-athlete; Typical athlete and non-athlete friend	DPW
Day-Cameron, Muse, Haustein, Simmons, & Correia	2009	30.14% (85)	85.8% (242)	Descriptive	Authors wrote own questions	Typical student	DPW; DPDD

Table 2 (cont.)

DeMartini, Carey, Lao, & Luciano	2011	38.9% (126)	67.0% (217)	Injunctive	Adapted BYAACQ	Typical student	DPW; Binge frequency
Doumas, Haustveit, & Coll	2010	43.4% (49)	70.0% (79)	Descriptive	DNRF	Typical student; Typical student athlete	DPW
Doumas, McKinley, & Book	2009	72.4% (55)	85.5% (65)	Descriptive	DNRF	Typical student	DPW; DPDD; RAPI; Peak drinks
Doumas, Workman, Smith, & Navarro	2011	70.4% (95)	83.7% (113)	Descriptive	DNRF	Typical student	DPW; RAPI
Durkin, Wolfe, & Clarke	2005	44.3% (646)	82.9% (1,210)	Descriptive; Injunctive	Authors wrote own questions	Best friends; Friends associated with most frequently	Binge frequency
Ferrer, Dillard, & Klein	2012	36.0% (86)	N/R	Descriptive; Injunctive	Authors wrote own questions; INQ	Same-age and same-sex students	DPW; BYAACQ
Ford	2007	39.0% (4,723)	76.0% (9,203)	Descriptive	Authors wrote own questions	Best friends	Binge frequency
Foster, Neighbors, & Krieger	2015	19.0% (47)	50.0% (124)	Descriptive; Injunctive	DNRF; Modified DNRF	Typical student	DPW
Geisner et al.	2015	46.0% (728)	68.4% (1,083)	Descriptive	DNRF	Typical student	DPW; YAAPST; Spring Break DPW
Ghee & Johnson	2008	45.0% (109)	77.2% (187)	Descriptive	AOD Norms Survey	Typical student; Same-sex and Same Greek status student; Typical on- and off-campus student; Athletes	DPW at parties
Glazer, Smith, Atkin, & Hamel	2010	39.1% (348)	80.0% (713)	Descriptive	Authors wrote own questions	Typical student	DPDD
Grazia-Monaci, Scacchi, Posa, & Trentin	2013	49.5% (98)	N/R	Descriptive	Authors wrote own questions	Best friends	DPW
Grossbard, Hummer, LaBrie, Pederson, & Neighbors	2009	43.6% (286)	78.1% (512)	Descriptive	Authors wrote own questions	Typical same-sex athlete	DPDD
Hagman, Clifford, & Noel	2007	40.0% (24)	91.7% (55)	Descriptive	Authors wrote own questions	Typical student; Same-sex student; Fraternity/sorority member	DPW; DPDD; Binge frequency
Ham & Hope	2005	62.3% (197)	90.0% (284)	Descriptive	Authors wrote own questions	Same-sex student; Best friends	DPW; RAPI

Table 2 (cont.)

Halim, Hasking, & Allen	2012	28.4% (65)	N/R	Descriptive; Injunctive	Social Norms Questionnaire; Authors wrote own questions	Typical student; Best friends	AUDIT
Ham & Hope	2006	60.5% (138)	90.8% (207)	Descriptive	Authors wrote own questions	Typical student; Same-sex student; Best friends	DPW; RAPI
Huchting, Lac, & LaBrie	2008	0.0% (0)	70.9% (175)	Descriptive	Authors wrote own questions	Same-sex and same Greek status;	DPW; DPDD; RAPI

Table 2 (cont.)

Hummer, LaBrie, & Lac	2009	43.3% (257)	79.5% (472)	Descriptive; Injunctive	CORE Survey; Modified HAQ	Typical athlete	DPW; DPDD; Peak drinks
Hummer, LaBrie, Lac, Sessoms, & Cail	2012	42.6% (763)	76.1% (1,362)	Descriptive	Authors wrote own questions	Same-sex student	DPW
Hummer, LaBrie, & Pedersen	2012	34.3% (221)	59.0% (380)	Descriptive; Injunctive	Authors wrote own questions; HAQ	Same-sex hall resident	DPDD
Neighbors, Borsari, Pearson, & Hustad	2014	50.8% (249)	90.8% (445)	Descriptive; Injunctive	DNRF; Authors wrote own questions	Same-sex student; Typical student	DPW
Iwamoto, Cheng, Lee, Takamatsu, & Gordon	2011	100% (776)	18.9% (147)	Descriptive	DNRF	Typical student	RAPI; Binge frequency
Iwamoto, Takamatsu, & Castellanos	2012	28.1% (443)	0.0% (0)	Descriptive	DNRF	Peer group	DPDD; RAPI
Jang	2012	52.9% (92)	0.0% (0)	Descriptive	Authors wrote own questions	Best friends	DPW
Jansinki & Ford	2007	35.9% (2,750)	74.00% (5,668)	Descriptive; Injunctive	College Alcohol Survey; Authors wrote own questions	Same-sex student; Typical student, Best friends, Parents	Any binge drinking
Johnston & White	2003	19.9% (46)	N/R	Descriptive; Injunctive	Authors wrote own questions	Important people; Friends, peers	Any binge drinking
Kuther & Timoshin	2003	48.1% (99)	84.0% (173)	Descriptive	Authors wrote own questions	Best friends; Parents	DPW
Kypri & Langley	2003	45.0% (704)	N/R	Descriptive	DNRF	Same-sex and same-age peers	AUDIT
LaBrie & Cail	2011	36.0% (759)	58.5% (444)	Descriptive	Authors wrote own questions	Same-sex peers from dorm floor	DPW
LaBrie, Atkins, Neighbors, Mirza, & Larimer	2012	39.6% (2,126)	81.4% (4,368)	Descriptive	DNRF	Typical student; Same-race student	DPW
LaBrie, Cail, Hummer, Lac, & Neighbors	2009	38.0% (1,374)	55.1% (1,992)	Descriptive	DNRF	Same-sex student	AUDIT
LaBrie, Hummer, & Neighbors	2008	30.0% (350)	66.0% (771)	Descriptive; Injunctive	CORE survey; HAQ	Same-Greek status student	Quantity
LaBrie, Hummer, Neighbors, & Larimer	2010	39.0% (1,464)	57.4% (2,154)	Injunctive	INQ	Typical student, Same-race; Same-Greek; Same-sex and -race; Same sex- and Greek; Same race and Greek; Best friends; Parents	DPW
LaBrie, Napper, & Ghaidarov	2012	32.8% (215)	60.3% (395)	Injunctive	INQ	Typical student	DPW; Driving after drinking
Larimer et al.	2011	42.0% (1,134)	74.6% (2012)	Descriptive	DNRF	Typical student; Same-sex; Same-race; Same-Greek; Same-sex and same-race; Same-sex and same Greek; Same-race and same Greek; Same-sex, race, and Greek	DPW

Table 2 (cont.)

Larimer, Turner, Mallett, & Geisner	2004	47.9% (279)	84.9% (494)	Descriptive; Injunctive	DNRF; HAQ	Same sex- and Greek student	DPW; RAPI; ADS score
Lau-Barraco & Linden	2014	27.2% (68)	54.4% (136)	Descriptive; Injunctive	DNRF; Authors wrote own questions	Best friends	DPW; BYAACQ; Binge frequency; Drinking days per week
Linden & Lau-Barraco	2013	26.7% (60)	54.2% (122)	Descriptive; Injunctive	DNRF; Authors wrote own questions	Best friends	DPW; Drinking days per week
Lederman, Stewart, & Russ	2007	37.7% (174)	61.5% (284)	Descriptive; Injunctive	PSRP	Typical student, Females, Males; Best friends	DPDD
Lee, Geisner, Lewis, Neighbors, & Larimer	2007	39.0% (546)	61.0% (854)	Descriptive; Injunctive	DNRF; INQ	Best friends	DPW
Lewis	2005	70.9% (112)	67.1% (106)	Descriptive	Authors wrote own questions	Typical student; Best friends	RAPI; Binge frequency
Lewis	2007	27.7% (65)	74.0% (174)	Descriptive	AOD Survey	Same- and opposite-sex student; Closest same- and opposite-sex friend	DPW; RAPI
Lewis	2008	46.5% (98)	78.2% (165)	Descriptive	AOD Survey	Typical student; Teammate; Male and female athlete; Male and female student	DPDD; Binge frequency
Lewis & Clemens	2008	27.7% (65)	74.0% (174)	Descriptive	Authors wrote own questions	Closest same- and opposite-sex friend	DPDD
Lewis & Neighbors	2006	46.2% (84)	89.0% (162)	Descriptive	Authors wrote own questions	Typical student; Same-sex student; Opposite-sex student	DPW
Lewis & Paladino	2008	46.5% (98)	78.2% (165)	Descriptive	AOD Survey	Typical student; Typical male and female athlete; Typical teammate	DPDD; Freq.
Lewis & Neighbors	2004	49.1% (111)	93.8% (212)	Descriptive	DNRF	Typical student; Same-sex student; Opposite-sex student	DPW
Lewis, Likis-Werle, & Fulton	2012	33.8% (69)	3.9% (8)	Descriptive	Authors wrote own questions	Best friends	DPDD; Binge frequency
Lewis et al.	2011	43.6% (640)	61.0% (895)	Descriptive	Authors wrote own questions	Same-sex student	DPDD
Lewis, Litt, & Neighbors	2015	37.0% (92)	69.1% (172)	Injunctive	Authors wrote own questions	Typical student	DPW
Lewis et al.	2010	43.1% (432)	60.0% (601)	Descriptive; Injunctive	DNRF; Authors wrote own questions	Same-sex student	DPW; YAAPST
Lewis, Rees, & Lee	2009	43.1% (432)	60.0% (601)	Descriptive; Injunctive	DNRF; Authors wrote own questions	Same-sex student	DPW; YAAPST
Linden, Lau-Barraco, & Braitman	2012	27.2% (68)	54.4% (136)	Injunctive	Authors wrote own questions	Best friends	DPW; DPDD; YAAPSTDrinking days per week
Litt & Lewis	2015	42.0% (880)	58.0% (1,216)	Descriptive	Authors wrote own questions	Same-sex and age non-drinker	DPW; DPDD
Litt, Lewis, Stahlbrandt, Firth, & Neighbors	2012	44.1% (212)	61.0% (293)	Descriptive	DNRF	Same-sex student	DPW; YAAPST

Table 2 (cont.)

Litt, Stack, & Lewis	2012	43.1% (149)	N/R	Descriptive	Authors wrote own questions	Best friends	N/R
Longstaff et al.	2015	39.7% (253)	81.4% (519)	Descriptive	Normative Beliefs Measure	Typical student; Best friends; Non-student peer	DPDD; Binge frequency; Past-month frequency
Maddock & Glanz	2005	35.3% (153)	13.4% (58)	Descriptive	Authors wrote own questions	Typical student; Best friends	DPDD; YAAPST; Drinking days per week
Mallett, Bachrach, & Turrisi	2009	34.0% (103)	47.9% (145)	Descriptive; Injunctive	DNRF; CORE Norms Survey	Same-sex student; Best friends; Typical student	DPW; DPDD
Martens, Dams-O'Connor, & Duffy-Paiement	2006	50.0% (80)	84.4% (135)	Descriptive	DNRF	Athlete best friend; Non-athlete best friend	DPW; DPDD; RAPI
Martens, Dams-O'Connor, Duffy-Paiement, & Gibson	2006	57.1% (97)	73.5% (125)	Descriptive	DNRF	Athlete best friend; Non-athlete best friend	DPW
Martin, Groth, Buckner, Gale, & Kramer	2013	26.2% (34)	0.0% (0)	Descriptive	DNRF	Same-sex student; Same-race student; Same-sex White student	DPW
McAlaney & McMahon	2007	34.4% (172)	N/R	Descriptive	Alcohol Use and Perception Survey	Best friends; Same-age student	DPDD
McAlaney et al.	2015	70.9% (3,176)	N/R	Descriptive; Injunctive	Authors wrote own questions	Same sex student;	DPDD; Past-two-month frequency
McCarthy, Lynch, & Pedersen	2007	40.6% (243)	87.0% (521)	Injunctive	Authors wrote own questions	Best friends	N/R
McMillan & Conner	2003	47.1% (222)	N/R	Descriptive; Injunctive	Authors wrote own questions	Best friends; Partner	DPW
Meisel & Palfai	2015	36.5% (57)	70.5% (110)	Injunctive	Modified DNRF	Best friends	DPW; Binge frequency
Miller, Prichard, Hutchinson, & Wilson	2014	0.0% (0)	61.2% (79)	Descriptive	Adapted AUDIT	Best friends; Typical male student; Typical female student	AUDIT
Neighbors, Dillard, Lewis, Bergstrom, & Neil	2006	42.1% (69)	91.5% (150)	Descriptive	DNRF	Typical student	DPW
Neighbors, Fossos, Woods, Fabiano, Sledge, & Frost	2007	37.2% (453)	84.9% (1,033)	Descriptive; Injunctive	DNRF; Authors wrote own questions	Typical student; Peers	DPW
Neighbors, Larimer, & Lewis	2004	41.2% (104)	79.4% (200)	Descriptive	DNRF	Typical student; Best friends	DPW; RAPI
Neighbors, Lee, Lewis, Fossos, & Larimer	2007	42.4% (347)	65.2% (533)	Descriptive; Injunctive	DNRF; Authors wrote own questions	Typical student; Best friends; Parents	DPW; RAPI
Neighbors et al.	2008	57.6% (467)	65.4% (530)	Descriptive; Injunctive	DNRF; INQ	Typical student; Same sex student; Best friends; Parents	DPW
Neighbors, Lee, Lewis, Fossos, & Walter	2009	41.7% (123)	61.0% (180)	Descriptive	Authors wrote own questions	Typical student	DPW; DPDD; Peak BAC

Table 2 (cont.)

Neighbors, Lewis, Bergstrom, & Larimer	2006	44.4% (95)	98.1% (210)	Descriptive	DNRF	Typical student	DPW; RAPI
Neighbors, Lindgren, Knee, Fossos, & DiBello	2011	39.8% (282)	65.5% (464)	Injunctive	Authors wrote own questions	Friends	DPW
Neighbors, Oster-Aaland, Bergstrom, & Lewis	2006a	37.8% (45)	95.0% (113)	Descriptive	DNRF	Typical student	DPDD; Peak BAC; Drinking at a bar
Table 2 (cont.)							
Neighbors, Oster-Aaland, Bergstrom, & Lewis	2006b	52.1% (73)	N/R	Descriptive	DNRF	Typical student	Drinking at a tailgate
Nguyen & Neighbors	2013	41.9% (307)	73.0% (534)	Injunctive	INQ	Parents; Friends	DPW
Norman, Conner, & Stride	2012	17.4% (30)	N/R	Descriptive	Authors wrote own questions	N/R	Binge frequency
Olthuis, Zamboanga, Martens, & Ham	2011	28.9% (87)	N/R	Injunctive	Authors wrote own questions	Parents; Coaches; Teammates	AUDIT; Binge freq.; Drinking games
Osberg, Insana, Eggert, & Billingsley	2011	37.8% (181)	88.1% (422)	Descriptive; Injunctive	Authors wrote own questions	Same-sex student; Typical student; Best friends	DPW; RAPI
Paek & Hove	2012	32.5% (1,778)	75.0% (4,104)	Descriptive; Injunctive	Authors wrote own questions	Typical student	DPW
Pearson & Hustad	2014	62.2% (544)	85.4% (747)	Descriptive; Injunctive	DNRF; Authors wrote own questions	Typical student	DPW; BYAACQ
Pedersen & LaBrie	2008	39.5% (206)	51.0% (266)	Descriptive	Authors wrote own questions	Typical student; Same-sex student; Opposite-sex student	DPDD
Pedersen, Larimer, & Lee	2010	17.0% (30)	72.9% (129)	Descriptive	DNRF	Typical student studying abroad in host country	DPW; DPDD; Any binge drinking
Pedersen, Neighbors, & LaBrie	2009	39.3% (205)	51.0% (266)	Descriptive	Authors wrote own questions	Typical student of each college year	DPW
Pengpid, Peltzer, & Van Der Heever	2013	57.6% (416)	N/R	Descriptive	Authors wrote own questions	Typical peer of same age, rank, and gender	AUDIT
Polonec, Major, & Atwood	2006	45.9% (127)	82.7% (229)	Descriptive	Authors wrote own questions	Typical student	Any binge drinking
Quinn & Fromme	2011	50.2% (116)	75.8% (175)	Descriptive	DNRF	Best friends	DPW; RAPI; Binge frequency
Reed, Lange, Croff, & Clapp	2007	31.5% (195)	46.3% (287)	Injunctive	Authors wrote own questions	Typical student; Best friends; Same-sex and Greek status student	DPDD
Read, Wood, & Capone	2005	44.1% (171)	87.1% (338)	Descriptive	Authors wrote own questions	Typical student	Past-year consequences
Real & Rimal	2007	45.2% (305)	N/R	Descriptive; Injunctive	Authors wrote own questions	Typical student; Admin.	DPW
Rice	2006	36.4% (437)	21.0% (252)	Descriptive	Authors wrote own questions	Same-race student	DPDD
Rimal & Real	2003	28.1% (99)	N/R	Descriptive; Injunctive	Authors wrote own questions	Typical student	DPW

Table 2 (cont.)

Rinker & Neighbors	2014	43.7% (479)	33.2% (364)	Descriptive	DNRF	Typical student	DPW
Rinker & Neighbors	2013	60.8% (257)	32.9% (139)	Injunctive	Quantity/ Frequency/ Peak Use Index	Best friends	Past-month abst.
Rinker & Neighbors	2008	43.7% (479)	33.2% (364)	Descriptive	DNRF	Typical student	DPW
Rutledge, McCarthy, & Lendyak	2014	32.6% (69)	98.1% (208)	Descriptive; Injunctive	CORE Survey	Typical student; Best friends	DPDD
Seitz, Wyrick, Rulison, Strack, & Fearnow-Kenney	2014	50.0% (1,577)	74.5% (2,350)	Injunctive	Authors wrote own questions	Teammates; Coaches	N/R
Talbott, Wilkinson, Moore, & Usdan	2014	27.6% (358)	69.7% (902)	Descriptive; Injunctive	Authors wrote own questions	Typical first year student; Best friends	DPDD
Terlecki, Buckner, Larimer, & Copeland	2012	67.3% (35)	90.4% (47)	Descriptive	DNRF	Typical student;	DPDD
Thombs, Ray-Tomasek, & Osborn	2005	31.5% (282)	90.1% (806)	Descriptive	Authors wrote own questions	Same-sex and opposite-sex student; Same-sex and opposite-sex close friends	DPDD
Trockel, Williams, & Reis	2003	100% (381)	N/R	Descriptive	Authors wrote own questions	Typical Greek Chapter member	DPW
Varvil-Weld, Turrisi, Hospital, Mallett, & Bamaca-Colbert	2014	30.1% (109)	0.0% (0)	Descriptive	Modified DDQ	Best friends	DPW; DPDD; AUDIT
Vaughan, Chang, Escobar, & de Dios	2015	34.7% (1,505)	0.0% (0)	Descriptive	Authors wrote own questions	Typical student	DPDD
Ward & Gryczynski	2009	44.5% (4,452)	72.4% (7,244)	Injunctive	Authors wrote own questions	Typical student; Family;	N/R
Wardell & Read	2013	33.0% (184)	70.4% (392)	Descriptive	Authors wrote own questions	Typical student; Same sex student	DPW; DPDD
Yanovitzky, Stewart, & Lederman	2006	38.0% (105)	60.1% (166)	Descriptive	Authors wrote own questions	Typical student; Best friends; Students at other universities; Fraternity members; Intercollegiate athletes	DPDD
Young & DeKlein	2012	43.3% (943)	56.2% (1,224)	Descriptive	Authors wrote own questions	Same sex student	AUDIT

Meta-Analytic Results

Descriptive Norms: Meta-Analysis. Of the 145 total studies, 125 contributed an effect size estimate for the relationship between descriptive norms and alcohol outcomes. Residual values were inspected for the presence of outliers using a cutoff of 1.96

(Borenstein et al., 2009). Three of the 125 effect size estimates were identified to have positive residual values above the cutoff, meaning that these studies reported a stronger than predicted correlation between descriptive norms and alcohol outcomes (Kuther & Timoshin, 2003; $r = 0.739$, residual = 2.52; Lee, Geisner, Lewis, Neighbors, & Larimer, 2007, $r = 0.673$, residual = 1.99; Lewis, Litt, & Neighbors, 2015, $r = 0.676$, residual = 1.98). Thus, analyses were conducted twice; once excluding these three studies ($k = 122$), and again including these three studies ($k = 125$).

The random-effects model excluding the three studies reporting effect sizes with large residual values was significant ($z = 19.85$, $p < .0001$), and yielded a positive association between descriptive norms and alcohol outcomes, Fisher's $z = 0.380$ ($SE = 0.019$, 95% CI = 0.342, 0.417; tau-squared = 0.04, $SE = 0.02$). Analyses were repeated including the three previously excluded studies. Results did not differ substantially. The random-effects model was significant ($z = 20.051$, $p < 0.001$), and resulted in a positive correlation between descriptive norms and alcohol outcomes, Fisher's $z = 0.392$ ($SE = 0.020$, 95% CI = 0.353, 0.430; tau-squared = 0.05, $SE = 0.026$). To provide a more conservative estimate of the overall effect size, the model excluding the outlier values was used in subsequent analyses.

For ease of interpretation, Fisher's z was transformed to r, resulting in a correlation of 0.363 (95% CI = 0.330, 0.395). A forest plot illustrating individual effect sizes for each of the 125 studies is displayed in Figure 2, and a histogram is displayed in Figure 3.

Figure 2. *Forest plot of descriptive norms and alcohol outcomes effect sizes.*

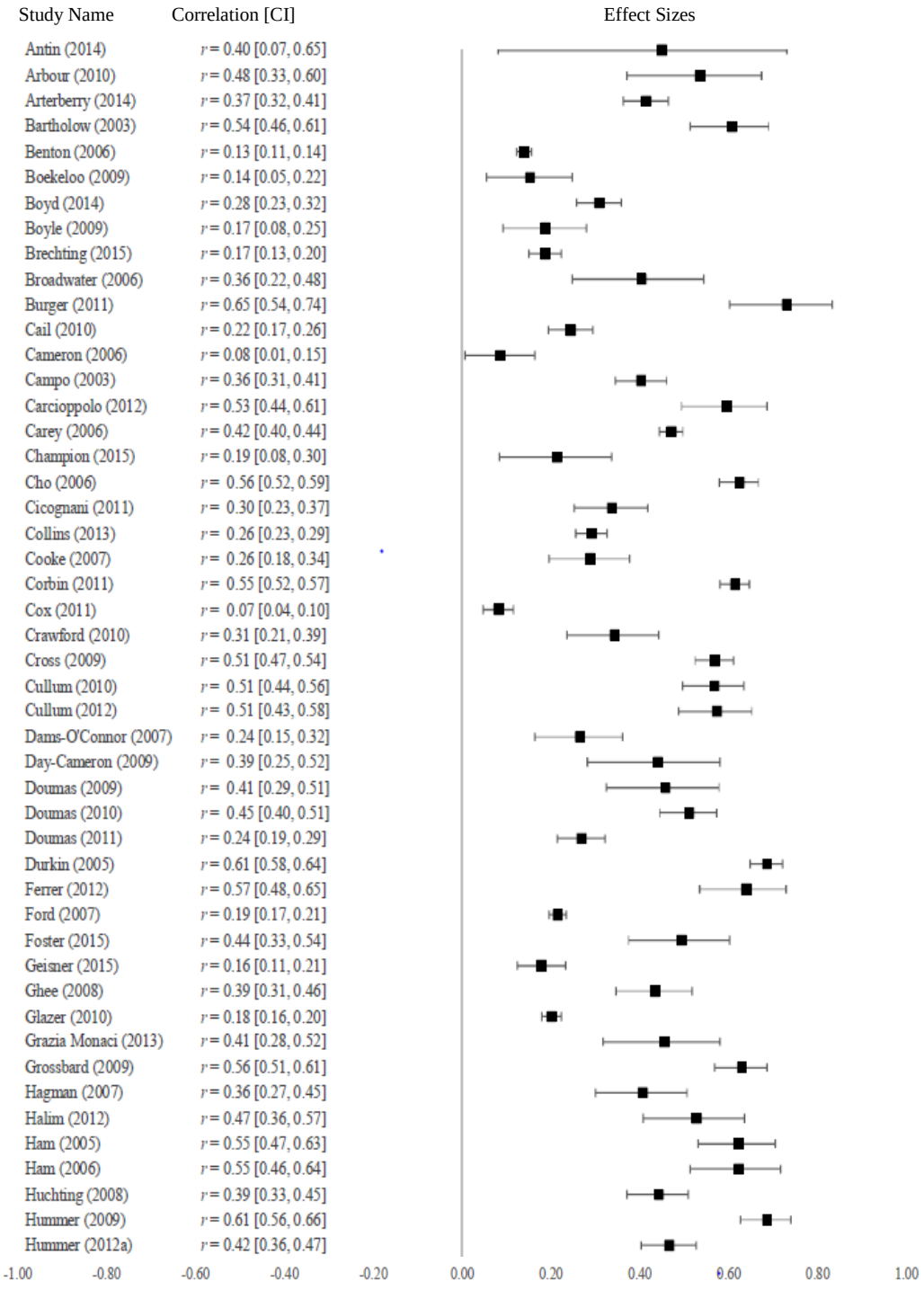


Figure 2 (cont.)

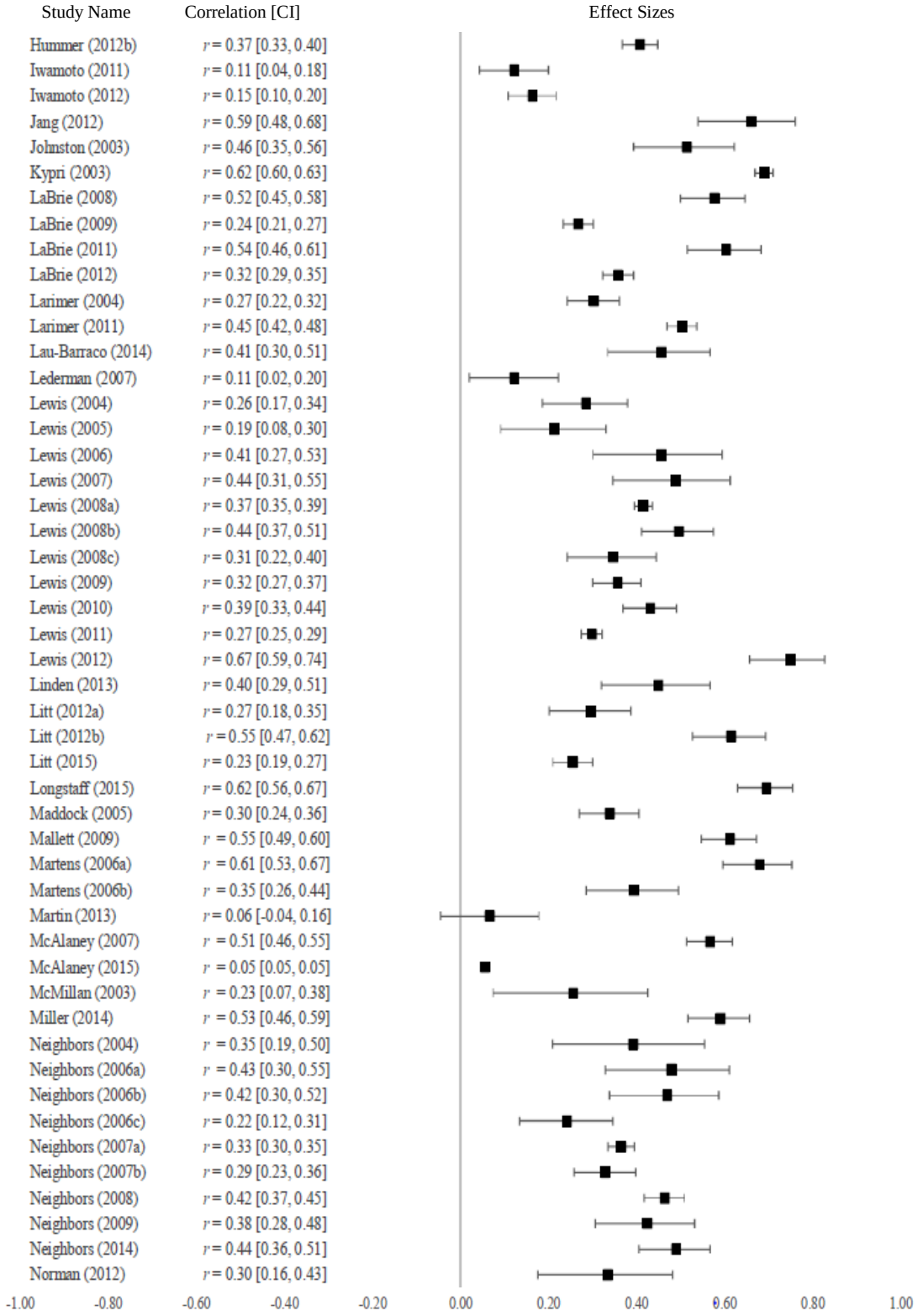


Figure 2 (cont.)

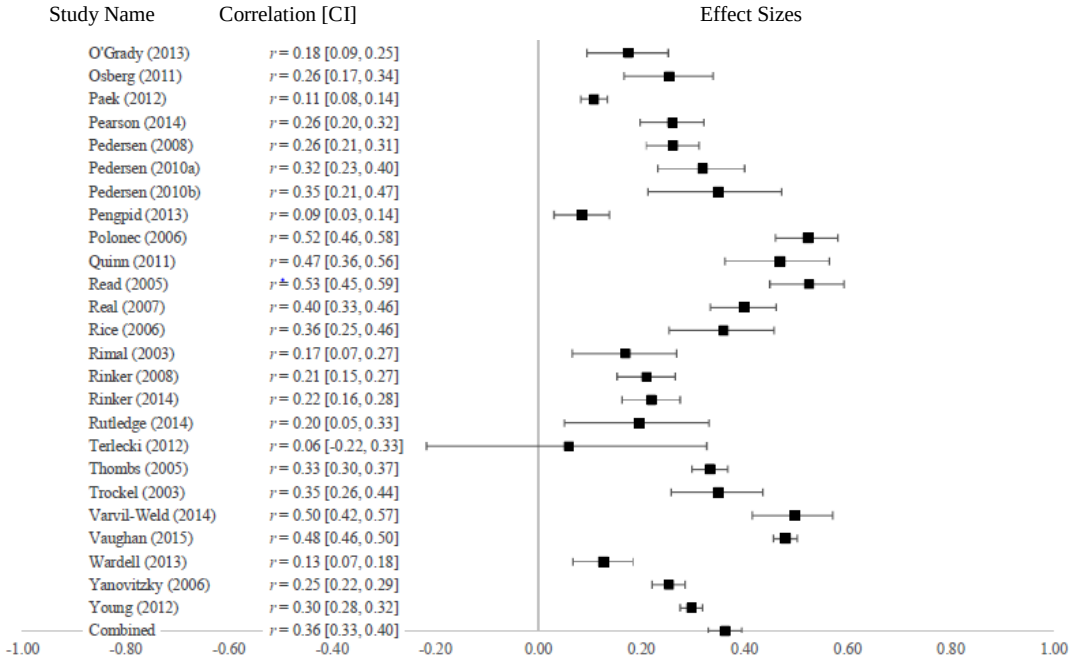
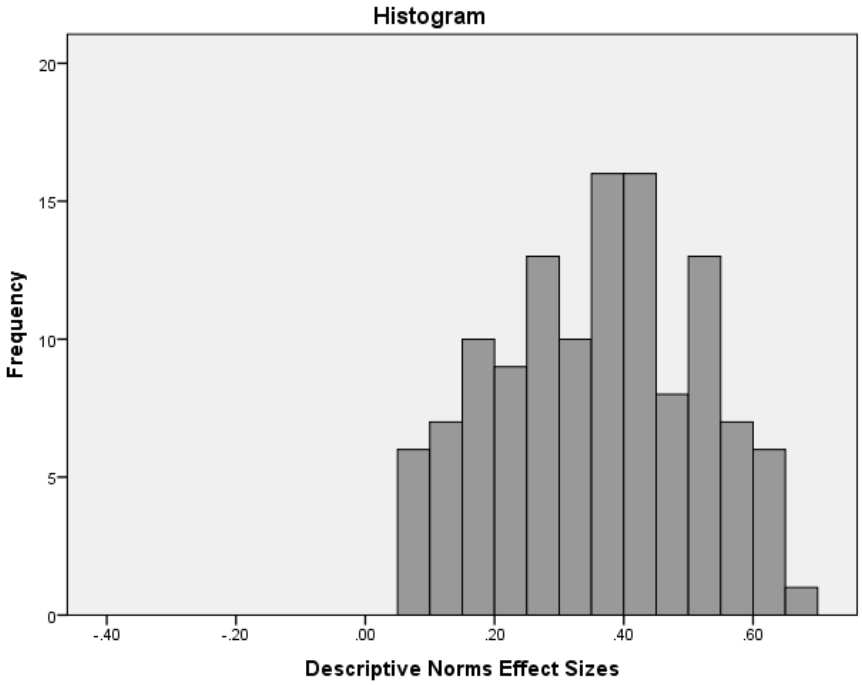


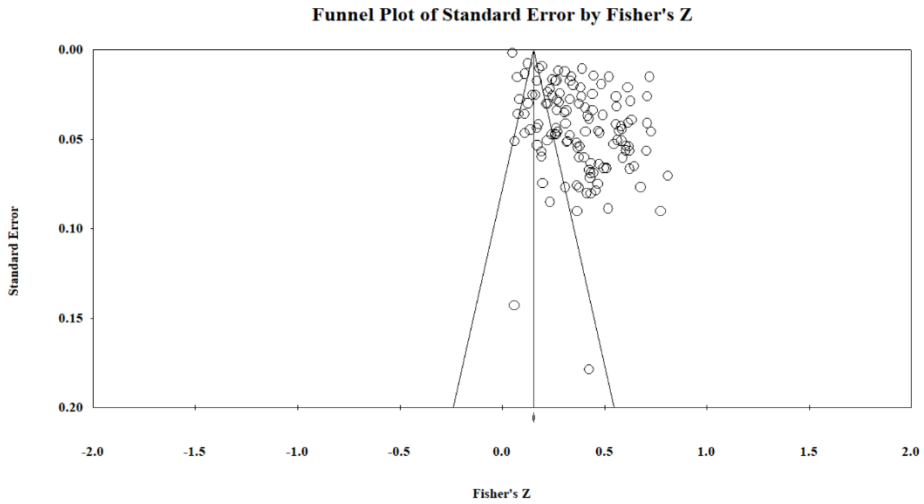
Figure 3. *Histogram depicting distribution of descriptive norms effect sizes.*



Significant heterogeneity was found in the distribution of effect sizes (Q (121) = 11,785.52; $p < .0001$). However, it is important to note that the significance testing of the Q-statistic was overpowered given the number of studies included in the meta-analysis (Higgins & Thompson, 2002). I^2 was 98.97, suggesting that 98.97% of the observed between-study variability was due to true heterogeneity rather than to sampling error.

Descriptive Norms: Publication Bias. Several methods were used to assess for the possible presence of publication bias. First, the funnel plot for studies examining descriptive norms and alcohol outcomes is displayed in Figure 4.

Figure 4. *Funnel plot for descriptive norms meta-analysis.*



Begg and Mazumdar's rank correlation, deemed appropriate for use in meta-analyses containing many studies (i.e., $k > 25$), suggested the presence of publication bias (Kendall's tau with continuity correction = -0.16, $z = 2.59$, p-value (1-tailed) = 0.005). Orwin's Fail-safe N was conducted to determine the number of missing studies there would need to be for the overall effect to become trivial, defined as 0.10. It was determined that 64 studies with a mean correlation of 0.00 would need to be added to the meta-analysis before the overall effect became trivial. Finally, Duval and Tweedie's trim

and fill procedure was used. Specifying a random-effects model, no samples were trimmed, resulting in an unchanged observed effect size. Considered together, the risk of publication bias is likely small. Furthermore, publication bias is difficult to assess in the presence of significant heterogeneity, as was evidenced in the present study (Hak, Van Rhee, & Surrmond, 2016).

Descriptive Norms: Subgroup Analyses. Several subgroup analyses were conducted for studies examining descriptive norms. First, studies were stratified by type of outcome measured: alcohol consumption or alcohol-related consequences. Alcohol consumption variables were defined as those measuring quantity or frequency of drinking (e.g., DPW; DPDD; drinking days per month; binge drinking.) Ninety-three individual effect sizes were calculated for descriptive norms and alcohol consumption, yielding an overall effect size estimate of $r_w = 0.37$ [0.33, 0.41], $z = 16.62$, $p < 0.01$. Alcohol-related consequences variables included AUDIT, RAPI, and B-YAACQ scores, as well as investigator-written consequence assessments. Thirty-seven individual effect size estimates were obtained, yielding an overall effect size of $r_w = 0.27$ [0.23, 0.31], $z = 12.74$, $p < 0.001$ for the relationship between descriptive norms and alcohol consequences.

Additional subgroup analyses were conducted to obtain separate effect size estimates by proximity of normative reference group. Reference groups were stratified into three categories: variants of the typical university student (e.g., “typical student”, “same-race student”, “same-sex student”); family members (e.g., “mom”, “dad”), and friends (e.g., “best friends”, “close friends”.) For the “typical student” normative reference group (80 individual effect sizes), there was an overall effect size of $r_w = 0.32$

[0.29, 0.35], $z = 19.99$, $p < 0.001$ between descriptive norms and alcohol outcomes. Only three individual effect sizes were identified for family member descriptive norms, yielding an overall effect size estimate of $r_w = 0.18$ [0.13, 0.23], $z = 6.76$, $p < 0.001$. Finally, 49 individual effect sizes were identified for "friends" descriptive norms, yielding an overall effect size estimate of $r_w = 0.47$ [0.40, 0.52], $z < 13.18$, $p < 0.001$.

Injunctive Norms: Meta-Analysis. Of the 145 total studies, 54 contributed an effect size estimate of the relationship between injunctive norms and alcohol outcomes. Residual values were inspected for the presence of outliers using a cutoff of 1.96. Three of the 54 studies were observed to have residual values above the cutoff (Johnston & White, 2003, $r = 0.690$, residual = 3.84; Seitz, Wyrick, Rulison, Strack, & Fearnow-Kenney, 2014, $r = 0.60$, residual = 3.16; Foster, Neighbors, & Krieger, 2015, $r = 0.530$, residual = 2.29). All three studies evidenced positive correlations between injunctive norms and alcohol outcomes that were stronger than predicted by the model. Thus, analyses were conducted twice; once excluding these three studies ($k = 51$), and again including these three studies ($k = 54$).

For the random-effects model excluding the three outlier values, the model was significant ($z = 11.631$; $p < .001$) and yielded a Fisher's z of 0.184 ($SE = 0.016$; 95% CI = 0.153, 0.215; tau-squared = 0.011, $SE = 0.005$). As expected, including the three studies with outlier values increased the effect size estimate. Including all 54 studies, the random-effects model was significant ($z = 9.73$; $p < .001$) and yielded a Fisher's z of 0.213 ($SE = 0.022$; 95% CI = 0.17, 0.256; tau-squared = 0.023, $SE = 0.011$). To yield a conservative effect size estimate, and to maintain consistency with the meta-analysis

conducted for descriptive norms, it was decided to use the random-effects model with the three outlier studies excluded.

For this model, Fisher's *z* was transformed to *r*, yielding a correlation of 0.182 (95% CI = 0.152, 0.212). A forest plot illustrating individual effect sizes for each of the 51 studies is displayed in Figure 5, and a histogram is displayed in Figure 6. Significant heterogeneity was found in the distribution of effect sizes (Q [50] = 1,328.065, $p < .001$). I^2 was 96.24, suggesting that 96.24% of the observed between-study variability was due to true heterogeneity rather than sampling error.

Figure 5. *Forest plot of individual correlations between injunctive norms and alcohol outcomes.*

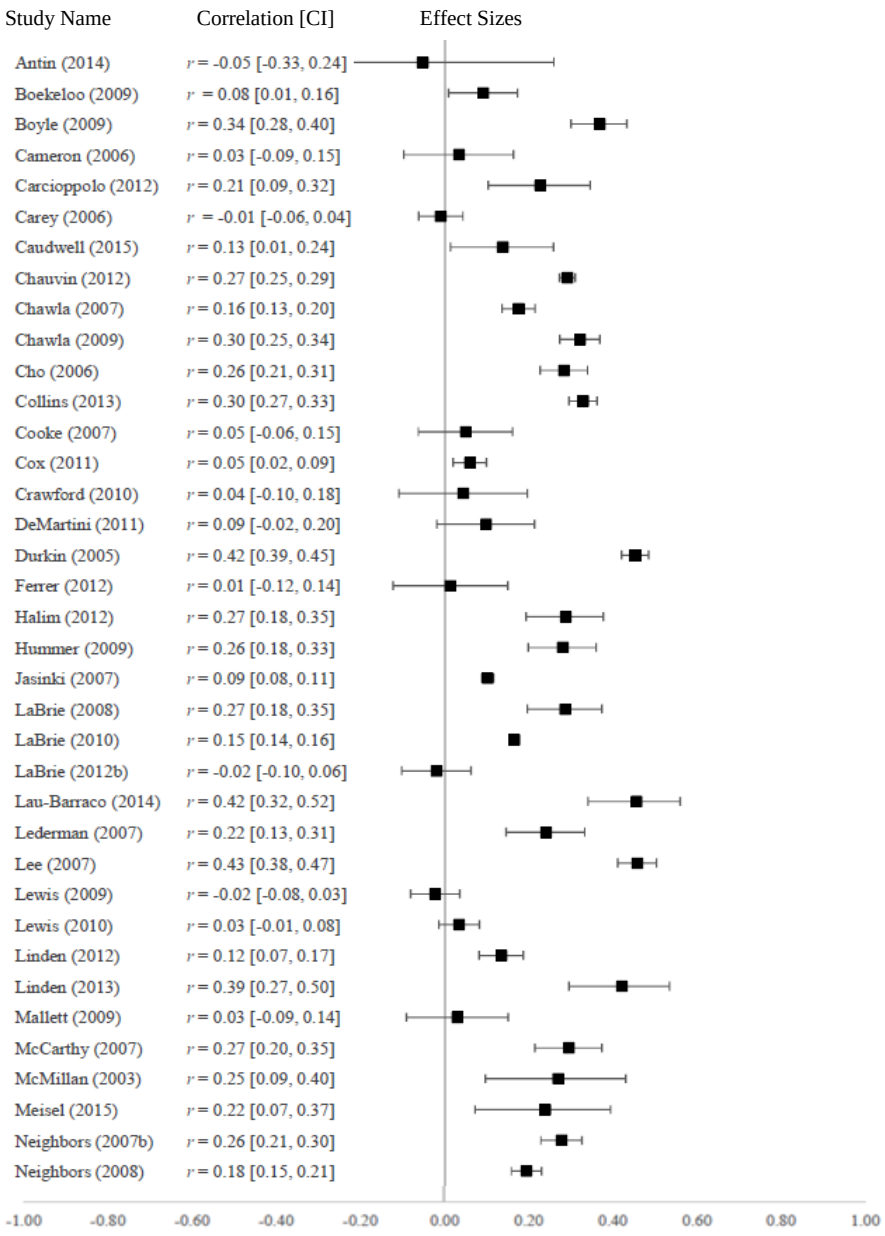


Figure 5. (cont.)

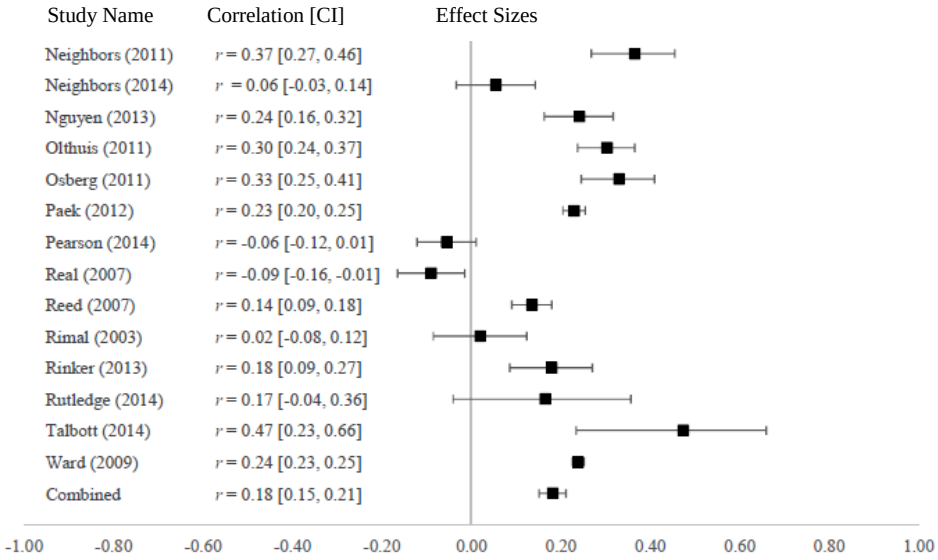
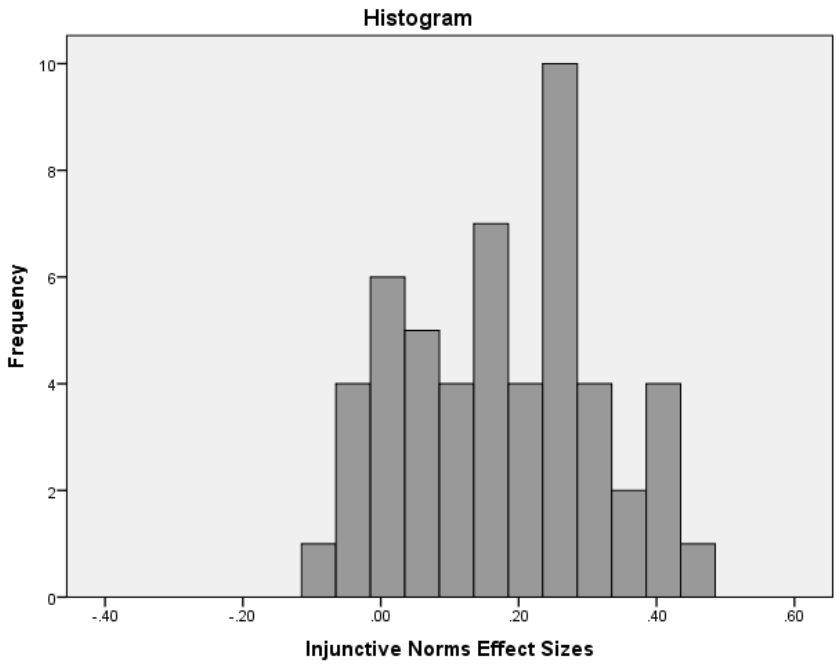
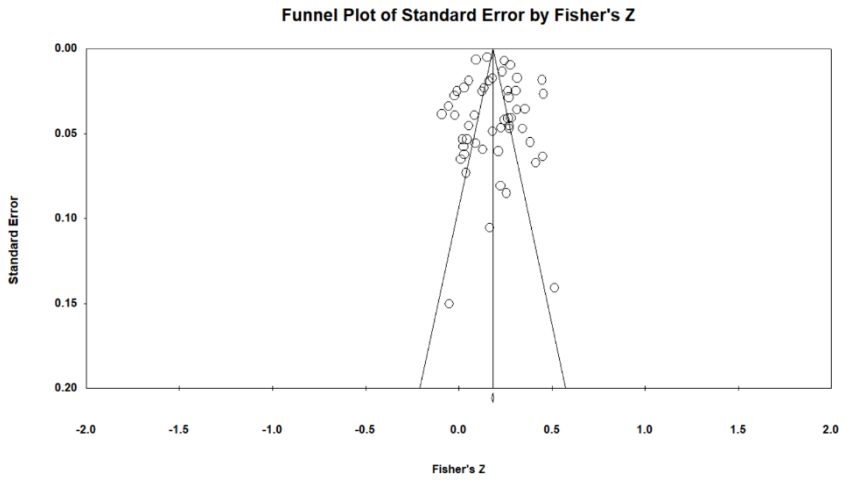


Figure 6. *Histogram depicting injunctive norms effect sizes.*



Injunctive Norms: Publication Bias. The funnel plot for studies yielding effect size estimates for the correlation between injunctive norms and alcohol outcomes is displayed in Figure 7.

Figure 7. *Funnel plot for injunctive norms meta-analysis.*



Begg and Mazumdar's rank correlation did not suggest the presence of publication bias (Kendall's tau with continuity correction = -0.039, z = 0.406, p-value [1-tailed] = 0.342). Orwin's Fail-safe N was conducted to determine the number of missing studies there would need to be for the overall effect to become trivial, defined as 0.10. It was determined that 42 studies with a mean correlation of 0.00 would need to be added to the meta-analysis before the overall effect became trivial. Using Duval and Tweedie's trim and fill procedure and specifying a random-effects model, no samples were trimmed, resulting in an unchanged observed effect size. Thus, there was deemed to be no evidence for publication bias in this meta-analysis.

Subgroup Analyses: Injunctive Norms. Subgroup analyses were also performed for studies examining injunctive norms. Studies were again stratified into two groups based upon type of outcome variable measured: alcohol consumption or alcohol-related

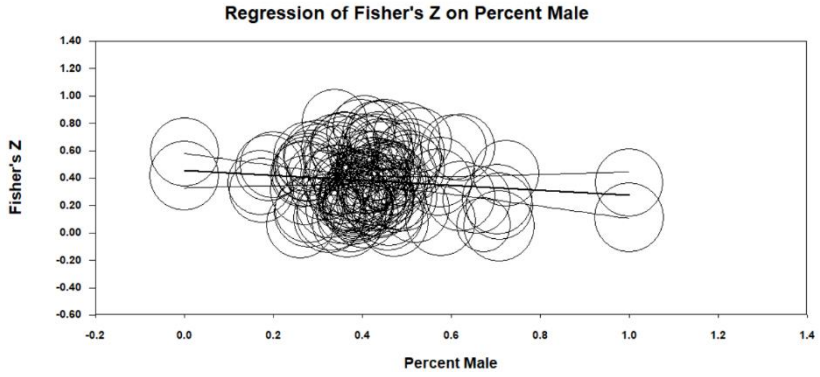
consequences. Studies examining "drinking composite" variables, and those measuring "drinking game participation", where it was not possible to discern the exact construct being measured were excluded from these analyses. Fifty-one individual effect size estimates were calculated for injunctive norms and alcohol consumption, yielding an overall effect size estimate of $r_w = 0.19$ [0.16, 0.23]; $z = 11.15$, $p < 0.001$. Twenty-two individual effect size estimates were calculated for injunctive norms and alcohol-related consequences, yielding an overall effect size estimate of $r_w = 0.18$ [0.14, 0.22]; $z = 8.52$, $p < 0.001$.

Injunctive norms studies were stratified by reference group: typical student, family members, and best friends. Thirty-eight individual effect size estimates were calculated for typical student injunctive norms and alcohol outcomes, yielding an overall effect size estimate of $r_w = 0.08$ [0.05, 0.12]; $z = 4.68$, $p < 0.001$. The thirteen individual effect size estimates for family injunctive norms and alcohol outcomes yielded an overall effect size estimate of $r_w = 0.26$ [0.17, 0.36], $z = 5.25$, $p < 0.001$. Finally, twenty-eight individual effect size estimates were calculated for best friends injunctive norms and alcohol outcomes, yielding an overall effect size estimate of $r_w = 0.31$ [0.25, 0.37]; $z = 9.69$, $p < 0.001$.

Meta-Regression. Random-effects meta-regression was performed for one of the hypothesized moderator of effect size: gender composition of study samples. The gender variable was calculated as percent males in the sample by dividing the number of males by the total number of participants in each study. For the descriptive norms meta-analysis, all but one of the 122 included studies reported on gender composition. The test of the model including gender composition as a predictor of effect size was not

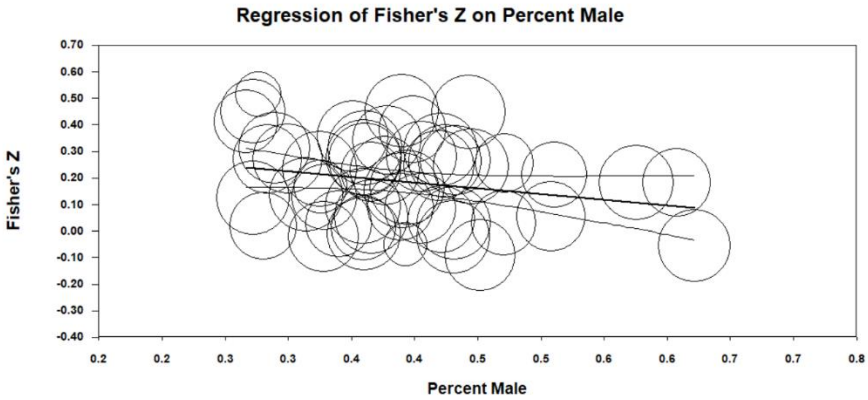
statistically significant, suggesting that effect size did not vary as a function of gender composition. Figure 8 presents a scatterplot of the regression of Fisher's *z* on percent male for the descriptive norms meta-analysis.

Figure 8. *Random-effects meta-regression examining "percent male" as a predictor of effect size using descriptive norms studies (k = 121).*



For the injunctive norms meta-analysis, 50 of the 51 studies reported on gender composition. The test of the model including gender composition as a predictor of effect size was statistically significant (b = -0.42; SE = 0.20; p = 0.04). Illustrated by the scatterplot in Figure 9, this suggests that, for injunctive norms studies, effect size decreased as percent males in the sample increased.

Figure 9. *Random-effects meta-regression examining "percent male" as a predictor of effect size using injunctive norms studies (k = 50).*



That is, there was a stronger relationship between injunctive norms and alcohol outcomes for samples consisting of a higher proportion of women.

Chapter 4: Discussion

Overall Summary

In the present study, two random-effects meta-analyses were conducted to yield effect size estimates for the relationships between descriptive and injunctive norms and college students' own alcohol outcomes. Data were extracted from articles on drinking norms and alcohol outcomes in college students published in English-language journals from 2003 to 2015. There was an overall medium (Cohen, 1992) positive association found between descriptive norms and college student alcohol outcomes (r_w = 0.36). A relatively weaker small positive association was found between injunctive norms and college student alcohol outcomes (r = 0.18). Thus, the present study found support for the assertion that students' perceptions of how much their peers drink and peer approval of alcohol use are positively associated with their own alcohol outcomes.

Descriptive Norms and Alcohol Outcomes

The most robust finding from the present study was the positive association between descriptive norms and alcohol outcomes. As previously stated, Borsari and Carey's (2003) meta-analysis provided support for the first tenet of Social Norms Theory: College students overestimate the amount their peers drink. Expanding upon this previous finding, the present study lends support for the second assertion of Social Norms Theory (e.g., Berkowitz, 2005); college students' perceptions of how much their peers drink are positively associated with their own alcohol use. Thus, findings from the present study

and from Borsari and Carey's previous meta-analysis, taken together, provided a fuller exploration and support for Social Norms Theory.

This research also expanded upon previous examinations of the Theory of Planned Behavior, which asserts that descriptive norms, along with self-efficacy and perceived behavioral control, predict intentions to drink, which subsequently predict actual alcohol use. The present study expands beyond intentions by providing evidence of a direct link between descriptive norms and drinking. As would be expected, the direct correlation between descriptive norms and alcohol outcomes was relatively weaker compared to an effect size found in a previous meta-analysis examining the relationship between descriptive norms and intentions (r_w = .47, Cooke, Dahdah, Norman, & French, 2016).

Difference in Findings between Descriptive and Injunctive Norms

There are several possible explanations for the finding of a weaker relationship between injunctive norms and alcohol use variables compared to descriptive norms. First, the difference in effect sizes may be explained by the way in which norms and alcohol outcomes were measured. Descriptive norms were typically measured using the Drinking Norms Rating Form, which assesses how many drinks students think their peers consume in a typical week (Baer et al., 1991). Drinks per week, a direct corollary of the DNRF, was used as a primary alcohol outcome in approximately half of studies examining descriptive norms (k = 59). In contrast, studies examining injunctive norms and alcohol use did not use the same construct to measure both variables. Injunctive norms were most often assessed as perceived approval for alcohol-related behaviors (e.g., passing out after drinking, driving after drinking). Despite this difference, over 60% of studies on

injunctive norms used drinks per week as a primary outcome variable (k = 33). Thus, a direct comparison between the effect sizes found between the two meta-analyses conducted in the present study does not account for this difference in constructs assessed. Researchers in the field are increasingly aware of this confound. Krieger and colleagues (2016) found that reconceptualizing injunctive norms to a drink-based (i.e., the number of drinks consumed considered to be acceptable by peers) rather than behavior-based metric resulted in a unique and positive relationship between injunctive norms and alcohol use. Future meta-analyses should incorporate studies examining drink-based injunctive norms and alcohol outcomes to evaluate whether the difference in the strength of the association between descriptive norms and alcohol outcomes and injunctive norms and alcohol outcomes is attenuated.

The finding of a weaker relationship between injunctive norms and alcohol outcomes in the present study may also be indicative of the more complex role that proximity of reference group is hypothesized to play in determining the relationship between injunctive norms and drinking. As previously discussed, several studies have found that when more distal reference groups are used to assess injunctive norms (i.e., perceived approval of the typical student), the relationship between injunctive norms and drinking is negative (e.g., Collins & Spelman, 2013; Neighbors et al., 2008). In addition, a recent prospective study found that, controlling for other predictors, typical student injunctive norms measured at baseline were negatively associated with drinking behavior measured at one-month follow-up (Lac & Donaldson, 2018). Examination of proximity of reference group as a predictor of the magnitude of the effect size between injunctive

norms and alcohol outcomes will likely elucidate whether injunctive norms are a productive target for college drinking interventions.

Implications of Subgroup Analyses

Stratifying study-level effect sizes by alcohol outcome measured and separately by proximity of the normative reference group yielded several interesting findings. For descriptive norms, the overall effect size between descriptive norms and variables that measured alcohol consumption was relatively stronger than the effect size between descriptive norms and alcohol-related consequences. However, this discrepancy was not evidenced for injunctive norms and alcohol consumption/alcohol-related consequences. There are several possible explanations for this finding. First, the relatively weaker correlation between descriptive norms and alcohol-related consequences is consistent with literature suggesting that even college students who drink regularly do not universally experience alcohol-related consequences. For example, in an analysis of B-YAACQ scores among students cited for a university alcohol violation (Kahler, Hustad, Barnett, Strong, & Borsari, 2008), 77% of the sample endorsed having a hangover and 64% endorsed having done or said something embarrassing while drinking over the past month. It is also clear that situational factors, such as students' surroundings when they drink, also play a role in whether consequences will occur.

Second, it is possible that the previously mentioned measurement concerns may account for the lack of discrepancy between injunctive norms and alcohol consumption/alcohol-related consequences. Theoretically, injunctive norms should be more strongly correlated with experience of alcohol-related consequences, given that injunctive norms are often operationalized as perceived approval for hazardous drinking

behaviors. However, the construct of approval for consequences still does not directly relate to the frequency with which students experience consequences. Rewording injunctive norms questionnaires to assess for approval of frequency of consequences (e.g., The typical student would approve of you passing out after drinking _____ times per year.") would likely increase the correlation between injunctive norms and experience of alcohol consequences.

Effect size estimates yielded by stratifying both descriptive and injunctive norms by proximity of reference group (e.g., "typical student", "family", "friends") were also consistent with findings in the extant literature. For descriptive norms, "friend" referents were most strongly correlated with alcohol outcomes, followed by "typical student" referents, and finally by "family" referents being least strongly correlated. It follows that, in the college environment, the amount of alcohol consumed by peers, either friends or the typical student, is likely more salient that family members' alcohol consumption. Furthermore, students may be more likely to estimate the amount of alcohol their peers consume to be similar to their own personal consumption. For injunctive norms, "friends" were also most strongly correlated with alcohol outcomes; "family" referents the second most strongly correlated; and "typical student" referent the least important. LaBrie and colleagues (2010) suggest that the opinions of others with whom the student has a personal relationship (i.e., friends and family members) are likely much more salient than those of others with whom the student does not have a relationship (i.e., the typical student). Results of these analyses confirm that "best friends" drinking norms are not a viable target for normative feedback interventions, as there is less discrepancy between

"best friends" drinking norms and students' own alcohol outcomes (e.g., Lewis & Neighbors, 2010).

Implications for Intervention

The primary practical application of drinking norms research has been to inform interventions for heavy drinking college students. Personalized Normative Feedback (PNF) interventions aim to reduce college drinking by correcting students' overestimations of descriptive norms, and by comparing students' own drinking to that of their peers. Several meta-analyses have found support for brief interventions, many including PNF components, in reducing college student drinking. One meta-analysis found that inclusion of PNF as a component of college alcohol interventions reduced alcohol-related consequences at short-term follow-up (Carey, Scott-Sheldon, Carey, & DeMartini, 2007). Another meta-analysis examining the impact of standalone PNF interventions found a small, positive effect for PNF in reducing drinking across a range of short-term follow-up periods (i.e., 20 weeks or less). However, in the same meta-analysis, a "less than small" effect was found for reductions in alcohol-related consequences, suggesting that PNF interventions were less effective by this metric (Dotson, Dunn, & Bowers, 2015). A systematic review found support for reduced descriptive norms as the only research-supported mediator of alcohol interventions and reduced drinking among college students, with support for mediation found in 64% of studies (Reid & Carey, 2015).

Findings from Reid and Carey's (2015) systematic review are also consistent with the present study's finding of a relatively weaker relationship between injunctive norms and alcohol variables. The authors designated injunctive norms as a "mediator [of the

efficacy of alcohol interventions] with limited support". Out of six studies examining change in injunctive norms as a potential mediator, only one found that injunctive norms were changed after intervention. However, the authors noted that only one of the six studies was specifically designed to target injunctive norms, so it is not yet possible from this review to draw definitive conclusions as to the potential role of injunctive norms in PNF interventions.

Limited recent inclusion of injunctive norms in PNF interventions has yielded mixed findings. Steers and colleagues (2016) compared PNF with and without injunctive norms feedback and found that adding injunctive norms feedback to the intervention did not lead to decreased levels of drinking. In contrast, the first randomized controlled trial of an injunctive-norms-based motivational intervention for college student drinkers found that correcting students' misperceptions of injunctive norms, either as a standalone intervention or in combination with descriptive normative feedback, resulted in greater decreases in alcohol use compared to a control condition (Prince, Maisto, Rice, & Carey, 2015). Variation in findings suggests that more research is needed to determine the role that changing injunctive norms might play in reducing college drinking.

It is important to note, however, that PNF interventions have not universally been found to be effective. Using an innovative approach to meta-analysis allowing for accommodation of the overrepresentation of "zeros" in alcohol datasets, the Project INTEGRATE team found that standalone PNF interventions did not have a significant effect in reducing drinking or experience of alcohol-related problems (Huh et al., 2015.) However, when combined with motivational interviewing, PNF interventions did have a significant but small effect on reducing alcohol-related problems. Thus, PNF

interventions should not be viewed as a gold-standard standalone approach to reducing college drinking. Rather, further research should be conducted on methods of optimizing PNF interventions given their potential to be cost-effective and relatively easy to administer.

Future Directions

Meta-analytic synthesis can serve the function of identifying gaps in an area of scientific research. Review of the present study suggests several promising future directions of inquiry in the drinking norms field. First, relatively few studies included either meta-analysis included a measure of alcohol consequences, such as the RAPI, B-YAACQ, or YAAPST. Adopting a harm reduction perspective would dictate that the relationship between drinking norms and consequences is more critical than that between drinking norms and alcohol use. Therefore, future studies should continue examining whether specifically targeting reductions in alcohol-related consequences through PNF interventions yields positive results.

The present study confirms that injunctive drinking norms have been examined with less frequency than descriptive norms. Although the small positive effect size found between injunctive norms and alcohol outcomes might suggest that injunctive drinking norms are not a productive area of study, the previously mentioned concerns about the discrepancy in measurement between injunctive norms and alcohol outcomes cannot be discounted. Future studies should examine the relationship between drink-based injunctive norms and alcohol outcomes. Once sufficient studies are conducted, future meta-analyses should incorporate studies using drink-based measurement of injunctive norms, and comparisons should be made between the effect sizes evidenced in these

novel studies and studies using traditional behavior-based measurement of injunctive norms.

Significant heterogeneity was found in both the descriptive norms and injunctive norms meta-analyses, suggesting the presence of moderator variables that influence the strength of the associations between drinking norms and alcohol variables. At the individual study level, many researchers have already examined potential moderators, including proximity of normative reference group (e.g., Cox & Bates, 2011; Dams-O'Connor, Martin, & Martens, 2007), gender (e.g., Lewis & Neighbors, 2004), ethnicity (e.g., Hagler, Pearson, Venner, & Greenfield, 2017), and social identity (e.g., Reed, Lange, Ketchie, & Clapp, 2007).

Random-effects meta-regression conducted in this meta-analysis suggested that gender significantly moderated the strength of the relationship between injunctive norms and alcohol outcomes, but not between descriptive norms and alcohol outcomes. For injunctive norms, the relationship between injunctive norms and alcohol outcomes was stronger for females than males. One possible explanation for this finding may be that female students are more heavily influenced by the opinions of their peers regarding acceptable drinking behavior. Lending support to this explanation is Merrill, Miller, Balestrieri, and Carey's (2016) finding that female students were significantly more interested in injunctive norms feedback than their male counterparts. Future meta-analytic examination of potential moderator variables can provide clarity as to for whom PNF interventions are most effective and improve targeted prevention efforts with heavy drinking college students. Site effects, such as university size, university-level racial/ethnic composition (e.g., Vaughan, Chang, Escobar, & Dios, 2015), religious

affiliation (e.g., Wells, 2010) and alcohol policy (e.g., Taylor, Johnson, Voas, & Turrisi, 2006) are also potential moderators of the relationships between norms and alcohol outcomes that should be examined in the future.

The application of Social Norms Theory to college student behavior has expanded beyond descriptive and injunctive norms and alcohol outcomes in recent years. For example, many studies have now assessed the relationship between descriptive and injunctive norms and behavior for non-alcohol substances (e.g., marijuana, Pearson, Liese, Dvorak, & Marijuana Outcomes Study Team, 2017; nonmedical use of prescription stimulants, Silvestri & Correia, 2016; risky sexual behavior, Lewis, Patrick, Mittman, & Kaysen, 2014 and Dardis, Murphy, Bill, & Gidycz, 2016; and use of protective behavioral strategies, Benton, Downey, Glider, & Benton, 2008). Correlations found in these areas have generally been significant and positive. As further research accumulates in these and other areas, meta-analytic review should be undertaken to determine promising future directions.

Limitations

The present study is limited by the inclusion of only baseline data on drinking norms and college alcohol behaviors. Due to this limitation, it is not possible to approximate any causal influences of descriptive norms in determining college student alcohol behaviors. Longitudinal research has yielded mixed findings, with some evidence for bidirectional influences of norms and alcohol quantity (Neighbors, Dillard, Lewis, Bergstrom, & Neil, 2006), so future meta-analyses should incorporate longitudinal data.

Another limitation of the present study was the inclusion of only published studies in the meta-analyses. As previously, discussed the “file-drawer” problem is a significant

threat to the validity of meta-analytic results. However, publication bias analyses conducted for both meta-analyses did not suggest the presence of publication bias, increasing confidence in the calculated effect size estimations.

This study was also limited by the examination of only college student samples. Although college years were identified as a particularly high-risk period for the experience of negative alcohol-related consequences, drinking norms have been shown to be associated with alcohol use/consequences in other populations, including military Veterans (e.g., Krieger, Pedersen, & Neighbors, 2017) and adolescents (e.g., Nesi, Rothenberg, Hussong, & Jackson, 2017). Given this study's exclusion criteria, it is unknown whether the results can be generalized to other populations.

Conclusions

College years are viewed by most students as a time when heavy drinking is the norm (Colby, Colby, & Raymond, 2009). By the time they leave college, many students have transitioned out of heavy alcohol use, reducing the amount they drink and experiencing fewer consequences (Nealis, Collins, Lee-Baggley, Sherry, & Stewart, 2016). However, during college, alcohol-related consequences continue to negatively impact students' lives, and some go on to develop alcohol use disorders. A thorough understanding of the relationships between descriptive and injunctive drinking norms and students' own alcohol outcomes can continue to highlight potential areas of intervention and harm reduction.

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