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A Multi-site Randomized Trial of Normative Feedback for Heavy Drinking: Social Comparison versus Social Comparison plus Correction of Normative Misperceptions

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Abstract

Objective—Given widespread alcohol misuse among college students, numerous intervention programs have been developed, including personalized normative feedback (PNF). Most research evaluating PNF assumes that presenting one's own perceived norms is necessary to correct normative misperceptions and thereby reduce drinking. Alternatively, simply providing social comparison information showing that one drinks more than others may be sufficient. The present study evaluated the efficacy of full PNF (one's own drinking, campus drinking rates, and perceived norms) and a partial personalized social comparison feedback (PSCF; one's own drinking and campus drinking rates) in a randomized trial among heavy-drinking college students.

Method—Participants included 623 heavy-drinking students from three universities. Assessments occurred at baseline and three- and six-months post-baseline.

Results—Primary analyses examined differences across four drinking outcomes (drinks per week, total drinks past month, frequency of past month drinking, and negative alcohol-related consequences) at three- and six-month follow-ups controlling for the baseline variable. Results revealed significant reductions across all alcohol consumption outcomes at three months in both intervention conditions compared to attention-control. Mediation analyses demonstrated significant indirect effects of the intervention on six-month drinking through changes in perceived norms at three months. Moreover, evidence emerged for changes in drinking at three months as a mediator of the association between PSCF and six-month perceived norms.

Conclusions—The present research suggests PNF may not require explicit consideration of one's perceived norms in order to be effective and that direct social comparison provides an alternative theoretical mechanism for PNF efficacy.

Keywords

college; alcohol; personalized normative feedback; social norms

A considerable body of research confirms that behavioral decisions regarding drinking among college students are heavily influenced by normative perceptions of significant referents' behaviors and beliefs (Borsari & Carey, 2003; Neighbors, Lee, Lewis, Fossos, & Larimer, 2007). This research is consistent with the Social Norms Approach (Berkowitz, 2004; Perkins, 2002), which has provided an important theoretical framework for understanding college student drinking. Students commonly and consistently overestimate the amount of alcohol their peers consume (Borsari & Carey, 2003; Lewis & Neighbors, 2004; Perkins, Meilman, Leichliter, Cashin, & Presley, 1999), with approximately 70% of students overestimating alcohol consumption by typical students at their college (Perkins, Haines, & Rice, 2005). These perceptions of peers' drinking are one of the strongest predictors of personal drinking behavior by college students, even when controlling for other known predictors of drinking including demographics, motives, and expectancies (Neighbors et al., 2007; Pederson, LaBrie, & Hummer, 2009; Perkins, 2002).

Based on data demonstrating the strong association between perceived descriptive norms and alcohol use in college populations, correction of normative misperceptions using personalized normative feedback (PNF) is a prominent focus of many college drinking intervention studies (for reviews see Carey et al., 2007; Crouce & Larimer, 2011; Lewis & Neighbors, 2006; Miller et al., 2013; Walters & Neighbors, 2005). Personalized normative feedback interventions typically provide graphical and text-based feedback contrasting three pieces of information: (1) a student's own self-reported drinking; (2) a student's perception of other students' drinking; and (3) actual drinking rates for a typical student on the same campus. When provided to heavy drinking participants, PNF is designed to highlight two pieces of information regarding normative beliefs known to influence drinking behavior, namely: (1) other students drink less than the participant drinks (social comparison information), and (2) other students drink less than the participant thinks they drink (normative misperception correction). Both stand-alone and multi-component computerized and web-based interventions that incorporate PNF have been found to reduce alcohol use in randomized clinical trials (Doumas, Haustveit, & Coll, 2010; LaBrie et al., 2013; Lewis & Neighbors, 2007; Martens, Smith, & Murphy, 2013; Neighbors, Larimer, & Lewis, 2004; Neighbors, Lewis, et al., 2010). Thus, there is relatively strong evidence of the efficacy of computerized and web-based PNF as an intervention strategy for reducing college student drinking.

Proposed Mechanisms of PNF

Despite the emerging evidence supporting the use of PNF, less is known about the mechanisms driving the efficacy of such interventions. It is unclear exactly which elements of PNF interventions are responsible for the reductions in college student drinking that have previously been observed. For example, PNF feedback (i.e., a student's own self-reported drinking, a student's perception of other students' drinking, and actual drinking rates for a typical student on the same campus) can be presented to participants in a way that explicitly

addresses the participant's own misperception of descriptive drinking norms. Alternatively, feedback can instead focus on comparing one's own behavior to that of the actual norm without any explicit correction of normative misperceptions. The former is typical of PNF delivery; however, the latter provides social comparison feedback rather than normative feedback that explicitly corrects misperceived norms.

Social comparison was originally defined as a way for people to evaluate themselves in the absence of objective standards (Festinger, 1954). Building on Festinger's original research, more recent literature has examined the role that social comparison plays in health-risk behaviors (Gibbons et al., 2003; Litt, Stock, & Lewis, 2012). This is not surprising given that past research has shown that risk judgments and decisions are strongly impacted by comparative reference points (Kahneman & Tversky, 1979; van der Pligt, 1996). Additionally, research has shown that people compare themselves with others who currently engage in risky behaviors when considering whether or not to engage in risky behavior (Gibbons & Gerrard, 1997). Taken together, these findings suggest that social comparisons play an important role in decisions to engage in health-risk behaviors. Therefore it is possible that highlighting the discrepancy between one's own drinking and the drinking of one's peers would impact personal behavior, even if it does not explicitly address normative misperceptions.

Although there is a growing consensus regarding the efficacy of PNF interventions, both theoretical and practical questions remain regarding how PNF impacts alcohol use. One such question is the extent to which the effects of PNF rely on explicit correction of normative misperceptions (contrasting one's own perception of drinking norms with the actual drinking norms), or whether a similar impact could be achieved through provision of social comparison feedback (contrasting one's own drinking with the actual norm) alone. Therefore, a primary aim of the present study was to determine whether the explicit correction of participants' normative misperceptions would lead to a more efficacious intervention than simply providing social comparison feedback to participants.

Conformity and Projection

An additional question regarding the relationship between changes in descriptive norms and changes in drinking behavior following normative interventions is the extent to which perceived norms impact behavior prospectively due to processes related to conformity (Asch, 1956), or conversely, whether behavior change is followed by changes in perceived norms, consistent with projection of one's own behavior onto one's perceptions of others. Pluralistic ignorance has been proposed as one explanation for the tendency to perceive others as engaging in more undesirable behaviors than oneself (Baer, Stacy, & Larimer, 1991; Marks, Graham & Hanson, 1992; Prentice & Miller, 1993), whereas false consensus effects (Marks & Miller, 1987) have been used to explain the process whereby one's own behavior is viewed as normative, which then serves as an anchor for estimating the behavior of others. Research on naturalistic changes in perceived norms and drinking behavior over time has provided support for both conformity (Marks et al., 1992; Neighbors et al., 2006) and projection (Read, Wood, Davidoff, McLacken, & Campbell, 2002) with some research suggesting reciprocal influences between perceived norms and drinking behavior over time

(Neighbors et al., 2006; Neighbors, Dillard, Lewis, Bergstrom, & Neil, 2006; Wardell & Read, 2013). However, experimentally manipulating norms through provision of normative feedback and assessing changes in both behavior and perceived norms longitudinally following such a manipulation provides a stronger test of the evidence in support of conformity and projection hypotheses.

Current Research

The current study was designed to address these gaps in the literature in the context of a multi-site randomized clinical trial, comparing personalized normative feedback plus personalized social comparison (PNF; including explicit feedback about the participants' own misperception of descriptive drinking norms) to personalized social comparison feedback (PSCF; a comparison of participants' behavior to the actual norm without any explicit correction of the misperception), and an attention-control condition (non-alcohol related feedback). We hypothesized that both intervention conditions would be efficacious in reducing alcohol use and negative consequences relative to attention-control at three- and six-months post-intervention, with the PNF condition showing greater efficacy than the PSCF condition. We further anticipated that changes in drinking outcomes would be mediated by changes in perceived descriptive norms, and this effect would be stronger for participants who received explicit misperception feedback in the PNF condition compared to those who did not in the PSCF condition. Finally, we hypothesized a reciprocal relationship between changes in descriptive norms and changes in drinking behavior over time following both interventions. Evidence demonstrating an association between changes in perceived norms and later changes in drinking would provide support for a conformity affect. Evidence demonstrating an association between changes in drinking and later changes in perceived norms provide support for a projection effect.

Method

Participants

Participant flow through the study is presented in the CONSORT table in Figure 1. Participants included 623 undergraduates (53% female) who were between the ages of 18 and 26 and met heavy drinking criteria, defined as individuals who reported drinking 4/5 drinks on one occasion for women and men respectively in the last month. Students were recruited from three universities with a mean age of 20.55 years ($SD = 1.70$). Participants reported the following racial backgrounds: 62% White/Caucasian, 1% Native American, 16% Asian, 5% Black/African American, 1% Native Hawaiian/Pacific Islander, 8% Mixed, and 7% Other. Furthermore, 21% of the sample was Hispanic. Demographics by site are reported in Table 1.

Participant recruitment and screening—A list of all registered students during the fall semester of 2012 was obtained from each of three universities; a large, public, commuter university in the south, a large, traditional university in the northwest, and a small, private, residential university in the west. Each campus invited a random sample of registered students ($N = 6,000$, $N = 2,027$, and $N = 1,497$, respectively) via email to participate in an online screening survey. In order to be eligible for the longitudinal trial, participants had to

be between 18 and 26 years old and report drinking at least four drinks on one occasion for women and at least five drinks on one occasion for men in the past month.

Of the 9,524 invited students, 2,280 (24%) completed the screening assessment, and 992 (43.5%) met screening criteria and were invited to participate in the longitudinal study. Of these, 623 (62.8%) completed the baseline assessment. There were 569 participants (91.3%) who completed the three-month follow-up and 530 participants (85%) who completed the six-month follow-up. A Federal Certificate of Confidentiality (CC-AA-12-33) was obtained for this research. All three sites received approval from their respective Institutional Review Boards.

Attrition—Attrition was examined as a function of baseline drinking and group assignment. A missingness variable was created by dichotomizing participants who completed both follow-up time points ($n = 529$, 84.9%) from those who did not complete one or both follow-up assessments ($n = 94$; 15.1%). Attrition did not vary significantly by gender or age. Overall, results indicated that heavier drinkers were more likely to drop out. Significant differences in dropout likelihood were evident for all consumption variables (i.e., drinks per week, drinks past 30 days, and drinking frequency), but not for alcohol-related problems. Logistic regression analyses were then used to predict missingness from interactions between baseline drinking measures and intervention condition. There were no significant group baseline differences in any of the alcohol outcomes. Thus, while reductions in drinking over time may be due in part to attrition, group differences in drinking reductions cannot be attributed to attrition effects.

Design, randomization, and power—Upon completion of the baseline survey, participants were automatically randomized using URN randomization to one of three conditions: gender-specific PNF ($N = 207$), gender-specific PSCF ($N = 209$), or attention-control feedback ($N = 207$). Sampling was stratified by gender and drinking (10 or more drinks per week versus 9 or less drinks as calculated by the Daily Drinking Questionnaire; see measures section). Past samples at these sites with similar screening criteria have yielded medians of about 10. Additionally, research assistants (RAs) were blind to the conditions of the participants.

A priori power analyses were conducted using the G-power software application and were based on ability to detect univariate intervention effects on proposed mediators and primary outcomes. Based on our previous intervention studies utilizing PNF for problem drinking among college students, we estimated that a sample of 600 with maximum attrition of 20% ($N = 480$) would yield adequate power to detect differences among groups with effect sizes in the small to medium range (Cohen, 1992; $d = .29$).

Procedures

Screening, baseline, three-month, and six-month follow-up procedures were similar across the three sites with specific differences noted below. Screening was conducted by sending emails to randomly selected students based on registrar's lists from each campus. Participants eligible to participate in the longitudinal study were invited to schedule an in-person lab visit for baseline and intervention at the end of their screening survey. Trained

RAs met the participants in the lab and assisted them on the baseline and intervention procedures. Once oriented, the participant completed the baseline survey on a computer and then, following the baseline survey, they received either: PNF, PSCF, or attention-control feedback. After reviewing their feedback, participants completed a post-intervention survey and were debriefed by the RAs. Participants also received a printed copy of their feedback to take with them.

Following completion of the baseline assessment and feedback, students were contacted three-months and six-months later to complete follow-up surveys online. Participants were contacted by means of phone calls, text messages (only to those who provided approval for being contacted by phone and texting) and emails to remind them to complete the assessments. At all three sites, participants were paid \$10 for screening. Participants were paid \$25 at baseline, three-month, and six-month follow-ups. Based on prior recruitment rates and incentives used in previous trials, one of the sites increased the incentives for the baseline assessment to \$50. Incentives for follow-up assessments did not differ across sites. Participants completed consent procedures prior to screening and were instructed that the screening assessment would take approximately 20 minutes and the baseline and both follow-up assessments would take 45 minutes.

Intervention Procedure

PNF intervention—The PNF intervention was modeled after gender-specific PNF interventions used in previous studies (Lewis & Neighbors, 2007; Neighbors et al., 2004; 2010). This brief intervention, aimed at correcting the misperception that other students drink more than they actually do, consisted of presenting feedback regarding: (1) a participant's own drinking behavior; (2) the participant's perceptions of other students' drinking behavior at that university; and (3) students at that university's actual drinking behavior. Participants saw this feedback regarding drinking behavior in both text and bar graphs. Each bar graph included bars for one's own drinking, perceptions of others' drinking, and others' actual drinking. Feedback was reported on four screens, the first displaying weekly drinking frequency, the second showing typical drinks consumed per occasion, the third consisting of the number of drinks consumed in a week, and the last screen presenting the participant's percentile rank based on their own reported number of drinks per week (based on the DDQ-see measures) when compared to other same-sex students at their university. In both the PNF and PSCF conditions, source information for the data from each campus was provided at the bottom of the respective screens for each school, noting that the norms information came from a previous survey conducted on each campus and listed the sample size for the survey referenced. For example, "This information comes from a 2012 self-report study which included a random sample of 1,052 [University name] students."

PSCF intervention—The PSCF condition was similar to the PNF condition; however, it only included information regarding one's own drinking and actual rates of others' drinking. Participants' perceptions of others' drinking were not included in this condition.

Attention-control intervention—In the attention-control condition, participants received information from a large survey at their university regarding how much time their fellow students spent doing various non-drinking related activities, such as exercising, texting, and playing video games. As an example, participants were told that the typical male [University name] student spends 2.2 hours a week playing video games. The attention-control feedback included both text and bar graphs for the non-drinking activities, and was similar to the feedback presented in the PNF and PSCF conditions, with the exception that it did not include references to alcohol.

Measures

Alcohol consumption—Drinking was evaluated using the Daily Drinking Questionnaire (DDQ; Collins, Parks, & Marlatt, 1985; Kivlahan et al., 1990). The DDQ asks participants to report on the number of standard drinks they consume on a typical occasion as well as their typical weekly drinking. The Timeline Follow-Back (TLFB; Sobell & Sobell, 1994; Tonigan et al., 1997) was also used to evaluate typical drinking over the past month. Participants were asked to recall when they drank and how much alcohol they consumed over the last 30 days. Finally, the Quantity-Frequency-Peak Alcohol Use Index (Baer, 1993; Marlatt, Baer, & Larimer, 1995) is a five-item measure that assessed participants' drinking. Items asked participants how many drinks they consumed on a peak drinking occasion as well as how many hours they spent drinking on that occasion. Participants were also asked how frequently they drank over the last month.

Alcohol-related problems—The frequency of experiencing alcohol-related problems during the past three months was assessed using the Young Adult Alcohol Problems Screening Test (YAAPST; Hurlbut & Sher, 1992). The YAAPST consists of 37 items related to negative alcohol consequences such as “have you felt very sick to your stomach or thrown up after drinking?” and “have you awakened the morning after a good bit of drinking and found that you could not remember a part of the evening before?” (Hurlbut & Sher, 1992). Items were dichotomized and summed to create composite scores.

Perceived descriptive norms—The Drinking Norms Rating Form (DNRF; Baer et al., 1991; Lewis & Neighbors, 2004) was used to assess perceived drinking norms. Participants were asked to estimate weekly drinking, frequency of drinking, and how many drinks per occasion are consumed for a typical same-sex student from their university.

Results

Descriptive Information and Correlations

Participants reported drinking an average of 10 drinks per week, about 37.5 drinks per month, and about 5 drinks per occasion. Participants believed that other students drank an average of 14 drinks per week. Please see Table 2 for a detailed description of means and standard deviations by intervention condition at all timepoints. Overall, there were significant positive correlations between all of the alcohol consumption variables (drinks per week, number of drinks in the past 30 days, and drinking frequency). Further, there were

significant positive associations among the consumption variables, alcohol-specific perceived norms, and alcohol-related consequences (YAAPST).

Intervention Effects on Perceived Norms

Primary analyses utilized generalized linear models and negative binomial distributions (Hilbe, 2011) to evaluate group differences with respect to perceived norms at three- and six-month follow-ups controlling for baseline measures of norms. Gender was included as a covariate. Intervention contrasts were dummy coded reflecting differences between PSCF and attention-control, between PNF and attention-control, and between PSCF and PNF.

Results presents in Table 3 show that there were reductions in drinking norms in both the PNF condition and the PSCF condition. Moreover, results revealed the intervention effects were present at both three and six-month follow ups. Effect sizes for the intervention effects were calculated using the formula $d=2t/\sqrt{df}$ (Rosenthal & Rosnow, 1991), where t was approximated by the ratio of unstandardized parameter estimates to their estimated standard errors. The effect sizes for both feedback conditions on changes in norms at three and six months were in the small to medium range, with PSCF $d = -.27$ and PNF $d = -.48$ at three months, and PSCF $d = -.23$ and PNF $d = -.35$ at six months. Subsequent analysis revealed that there were no differences between the PNF and PSCF conditions with regards to changes in norms.

Intervention Effects on Alcohol Consumption

Analyses examining typical drinks per week, drinks in the past month, drinking frequency, and negative consequences followed the same strategy that was used for examining alcohol-related norms outcomes. Results presented in Table 3 revealed a consistent pattern across outcomes. Specifically, there were significant reductions across consumption outcomes at three-months in both the PNF condition and the PSCF condition relative to attention-control. The effect sizes for both the PSCF as well as the PNF condition on typical drinks per week, drinks in the past month, and drinking frequency at three-month follow-up were in the small range and ranged from $d = -.13$ to $-.21$ for PSCF and $d = -.12$ to $-.28$ for PNF. These effects were no longer evident at six-month follow-up. At the six-month follow-up effect sizes for the PSCF condition ranged from $d = -.02$ to $-.11$ and the PNF condition ranged from $d = -.09$ to $-.13$. Furthermore, subsequent analyses indicated one significant difference between the PNF and PSCF conditions with respect to drinks per week at the three-month follow up suggesting the PSCF condition was associated with a greater reduction in drinks per week.

Results presented in Table 3 for the YAAPST show that there were no significant reductions in alcohol-related problems as a function of the intervention. The effect size for the PNF condition was $d = -.12$ and for the PSCF condition was $d = -.13$. Additional analysis revealed there were no significant differences between PNF and PSCF conditions.

Site differences—We tested whether the three sites showed differences in drinking by examining the two dummy-coded site variables in the primary analyses. As can be seen in Table 3, students at Sites 2 and 3 consumed more drinks per week at both follow-ups than

students at Site 1. Students at Sites 2 and 3 did not differ from each other in their drinking levels. Students at Site 3 also reported higher levels of past 30-day drinking than students at Site 1, but there was no difference between students at Site 1 and those at Site 2. Students at Sites 2 and 3 reported drinking more frequently than students at Site 1 at the six-month follow-up. Finally, there were no differences in alcohol-related problems by site.

Mediation

Mediation analyses were conducted to evaluate the temporal precedence of changes in norms and changes in drinking in the context of feedback interventions. Mediation was tested using PROCESS (Hayes, 2012). Bootstrapping (1,000 samples) was used to estimate standard errors. Changes in perceived norms and changes in drinking were constructed by residualizing follow-up outcomes on baseline outcomes. For example, change in perceived norms at three-months was calculated by predicting three-month perceived norms from baseline perceived norms and saving the unstandardized residuals. We then tested for indirect effects of the mediator on six-month outcomes, controlling for site, gender, and the baseline outcome variable.

Conformity—The conformity hypothesis was evaluated by examining changes in perceived norms at the three-month follow-up as a mediator of intervention effects (i.e., PNF versus attention-control and PSCF versus attention-control) on drinks per week at six-month follow-up, controlling for baseline drinks per week. Baseline drinks per week was selected because quantity measures, such as typical weekly consumption, have been suggested to be among the best predictors of alcohol-related problems (Borsari, Neal, Collins, & Carey, 2001) and because we had a comparable variable for norms (i.e., perceived typical drinks per week).

Results with estimates may be seen graphically in Figure 2. Both PNF and PSCF had significant effects on changes in perceived norms three months later ($ps < .001$). These changes in perceived norms were also associated with drinking at the six-month follow-up ($p < .001$). Moreover, results revealed significant indirect effects of both PNF [95% CI: $-1.22, -.28$] and PSCF [95% CI: $-.78, -.14$] on six-month drinking through changes in perceived norms. Thus, the conformity hypothesis was supported by the present findings.

Projection—The projection hypothesis was evaluated by examining changes in drinks per week at the three-month follow-up as a mediator of intervention effects on six-month perceived norms, controlling for baseline perceived norms. Results with estimates are shown in Figure 3. PSCF was marginally associated with changes in drinks per week at the three-month follow-up ($p = .074$), but PNF was not associated with changes in drinking at 3 months. Changes in drinking were, however, associated with perceived norms at six months ($p = .002$). Mediation results were consistent: results revealed significant indirect effects for PSCF versus attention-control [95% CI: $-.36, -.01$], but not for PNF versus attention-control [95% CI: $-.42, .01$]. Thus, the projection hypothesis was supported for the PSCF condition, but not the PNF condition.

Discussion

The present research provides informative and novel findings related to brief college student drinking interventions. This is the first study to experimentally manipulate specific discrepancy components of normative comparison feedback by comparing PNF (one's own drinking rates, normative perceptions, and campus drinking rates) to PSCF (one's own drinking and campus drinking rates). Moreover, this is the first examination of PSCF efficacy on college student drinking. The current findings indicated that for alcohol consumption, both PNF and PSCF, when compared to attention-control, reduced total drinks per month, typical drinks per week, and typical monthly drinking frequency at three-month follow-up. The intervention effects were not observed in six-month outcomes; this may be partially due to the absence of repeated administration or boosters. Although previous work with PNF has found results without repeated administration of the feedback (e.g., Neighbors et al., 2010), it is possible that effects of the feedback declined over time in this sample. Findings further indicated there were no significant differences when directly comparing PNF and PSCF. Effect sizes for both PNF and PSCF were in the small range. Alcohol-related negative consequences were not reduced by either intervention at either of the follow-ups. Results are consistent with other research that found interventions were less successful in reducing problems (compared with controls) when they were targeted to specific groups of drinking college students, rather than all college students (Carey et al., 2007). Additionally, the focus of the feedback was on drinking, rather than on problems. It is also possible that six-month follow-up was simply not enough time to capture reductions in negative consequences, which is supported by other research indicating longer-term emergent effects on alcohol-related consequences, particularly in regards to in-person brief interventions (Carey et al., 2007; Schaus et al., 2009).

When examining descriptive drinking norms, the results indicated that PNF and PSCF reduced descriptive norms at both three- and six-month follow-up assessments. Effect sizes indicated that PNF had stronger effects ($d = .48$ at three months; $d = .35$ at six months) on reducing normative perceptions than PSCF ($d = .27$ at three months; $d = .23$ at six months) when compared to attention-control. However, when directly comparing PNF to PSCF, findings indicated no significant differences. Thus, similar to drinking, providing a comparison between actual drinking norms and one's own drinking behavior was enough to reduce normative perceptions. This suggests that emphasizing the discrepancy between actual drinking and the perceived drinking norm that highlights “most students don't drink as much as you think they do” is not necessary to reduce normative perceptions. One additional potential explanation for the different effect sizes may be due, at least in part, to the likelihood that individuals may be exposed to varying degrees of social comparison information. While most people in the sample (94%) drank more than the means presented, some drank considerably more than the norms whereas others drank more similarly to the norms.

In examining conformity versus projection mediation hypotheses, we examined whether changes in norms at three months were associated with changes in drinking at six months (conformity), and conversely, whether changes in drinking at three-months were associated with changes in norms at six months (projection). Both interventions were associated with

changes in norms at three months, which were then associated with changes in drinking at six months. Combined with the mediation results here and in previous literature, these findings are consistent with a conformity explanation. Concurrently, results also indicated that changes in drinking were associated with subsequent changes in norms, at least for the PSCF condition. These findings are more consistent with a projection explanation, specifically a false consensus effect. In sum, results suggest that both conformity and projection are evident in associations between changes in perceived norms and changes in drinking. Furthermore, these results are consistent with research that has shown both reciprocal relationships (conformity and projection; Ferrer, Dillard, & Klein, 2012) and conformity (Neighbors et al., 2006) between descriptive norms and drinking behavior. However, this is the first study to date that has looked at both of these relationships over time using an experimental drinking intervention design. Further research is warranted to better understand what is driving the social norms approach. If presenting the discrepancy between normative perceptions and actual drinking rates (i.e., most people don't drink as much as you think they do) is not the important discrepancy, and rather it is the discrepancy between one's own drinking and actual drinking rates (i.e., most people don't drink as much as you do), then the current projection results may muddy past findings.

Clinical Implications

Results suggest several clinical implications. First, given that PNF and PSCF yield similar reductions in alcohol use, one might consider using a more parsimonious approach and provide personal versus actual norms and leave out the normative perception piece. Research has indicated that when it comes to brief interventions, there is no added advantage of longer interventions in college student samples (Kulesza et al., 2013). Using this as a guide, clinicians may choose to provide PSCF rather than PNF. However, one could also argue that using PNF, which provides two types of information (deviation from the norm and normative misperceptions) can better “hook” individuals into the feedback. It may also be viewed as less confrontational to include both pieces of information so that the focus is not solely on personal deviations from the norm. In addition, full PNF had a larger effect size in reducing normative perceptions than PSCF. Taking all this into account, it may be recommended for clinicians or organizations to utilize PNF over PSCF. Moreover it is possible that the less complex information provided by the PSCF may result in less deliberate processing, which might account for trends in the direction of better effects for PNF.

Limitations and Future Directions

Limitations for the present study include the focus on college students. It is unknown if the current findings would generalize to a young adult population not attending college. This concern is somewhat lessened considering that findings were similar across three diverse campuses. However, future research still needs to examine the efficacy of PNF or PSCF in non-college young adult populations. An additional limitation is the difference in payment across campuses. Two campuses paid participants similar amounts for the baseline assessment whereas one campus paid a higher amount. Finally selective attrition was present in the study with heavier drinkers being more likely to drop out. Although attrition did not

vary by group it may be important to consider that selective attrition would likely result in overestimated within group effect sizes.

Conclusions

Results from the present study indicate that both personalized normative feedback (PNF) and personalized social comparison feedback (PSCF) show promise in reducing normative perceptions of alcohol use among students, and that these reductions operate through both conformity and projection. The present results can be used to inform future brief college student drinking interventions. In addition, this is the first study to experimentally manipulate specific discrepancy components of normative comparison feedback by comparing PNF to PSCF, and moreover, is the first examination of PSCF efficacy on college student drinking. The results from this study yield important insights into the extent to which the effect of PNF relies on explicit correction of the normative misperception (contrasting one's own perception of drinking norms with the actual drinking norms) or whether similar effects could be achieved through provision of social comparison feedback (contrasting one's own drinking with the actual norm) alone. Understanding the mechanisms through which normative feedback reduces alcohol use is of utmost importance as researchers and clinicians continue to develop and refine alcohol intervention strategies for college students.

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Public Health Significance

Heavy drinking among college students remains a significant problem. Novel web-based brief interventions have potential to reduce drinking and can be widely disseminated. The results of this study suggest that explicit consideration of one's perceptions of other's drinking is not necessary to reduce drinking among college students. A direct comparison between one's drinking and other students' drinking may be just as effective in reducing heavy episodic drinking among college students.

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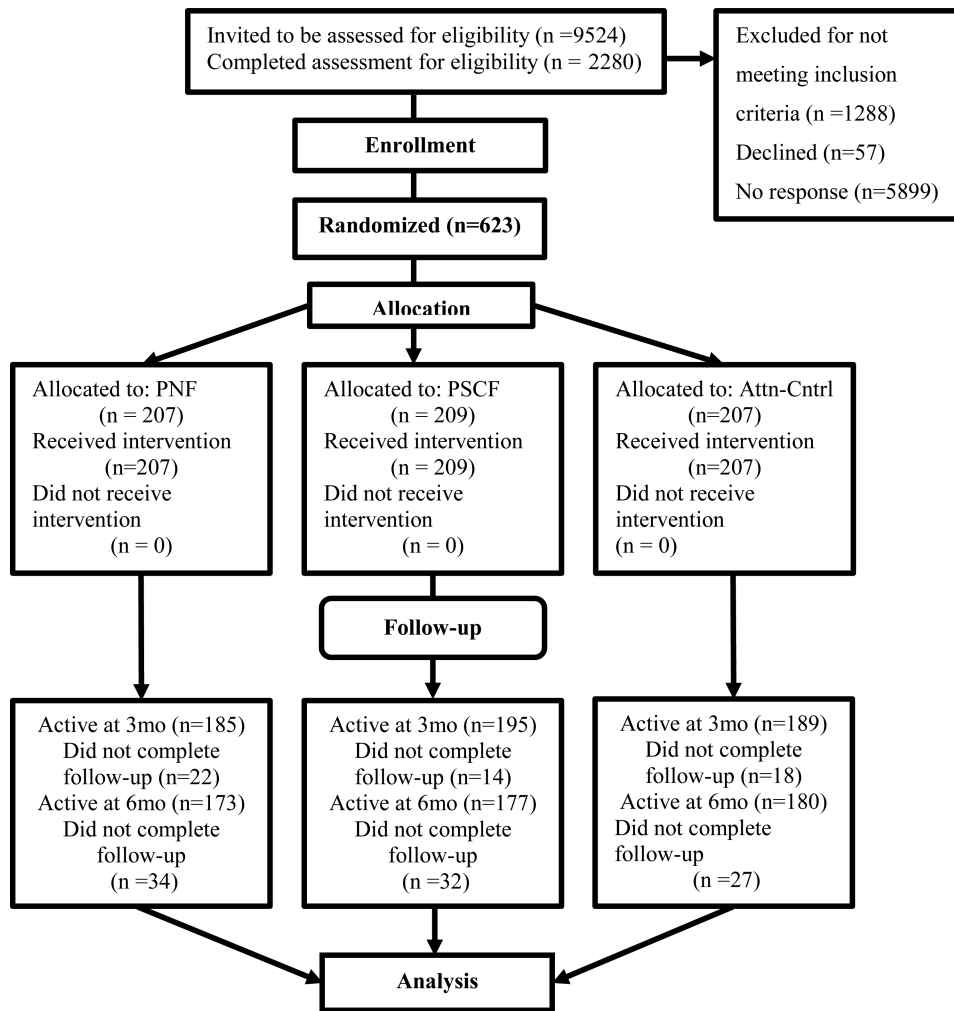


Figure 1. Participant flow. PNF = Personalized Normative Feedback; PSCF = Personalized Social Comparison Feedback.

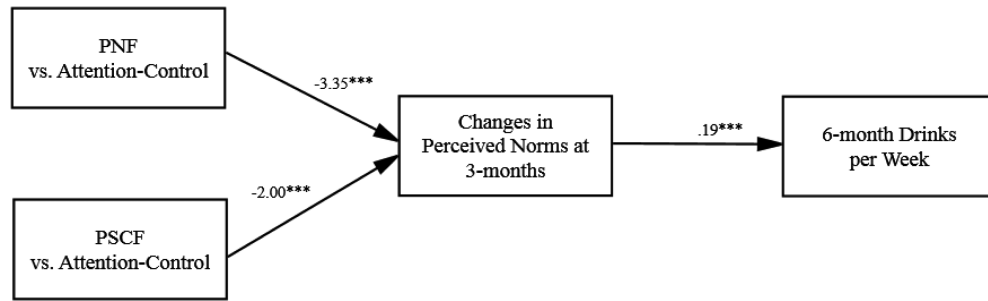


Figure 2. Conformity hypothesis: Changes in perceived norms at three-months as a mediator of intervention effects on drinks per week at six-months. *** $p < .001$

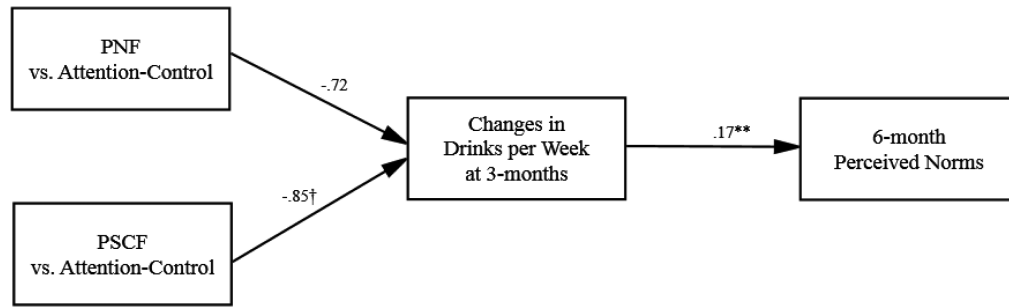


Figure 3. Projection hypothesis: Changes in drinks per week at three-months as a mediator of intervention effects on perceived norms at six-months. ** $p < .01$. † $p < .10$

Table 1

Demographics by Site

Variable		Site 1	Site 2	Site 3
		Mean (SD)	Mean (SD)	Mean (SD)
Age		21.09 (1.96)	20.77 (1.56)	19.79 (1.2)
Gender	Female	51.96%	52.11%	55.67%
Race	White	44.33%	69.34%	71.57%
	Native American	1.48%	0.94%	0.49%
	Black/African American	13.30%	0.00%	2.94%
	Asian	22.17%	16.04%	8.33%
	Native Hawaiian	0.49%	1.89%	0%
	Multi-Ethnic	8.87%	8.02%	8.33%
	Other	9.36%	3.77%	8.33%
Ethnicity	Hispanic	31.55%	9.39%	23.04%

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Table 2

Descriptive Statistics: Means and Standard Deviations for Alcohol Outcomes by Intervention Condition at all Timepoints

Baseline						
Variable	PNF Mean (SD)		PSCF Mean (SD)		Attention-Control Mean (SD)	
Drinks Per Week	10.59	(10.13)	10.14	(9.17)	9.38	(6.87)
Drinks past 30 days	39.67	(42.26)	38.60	(38.08)	34.41	(27.88)
Frequency	5.32	(2.04)	5.35	(1.92)	5.16	(1.73)
YAAPST	4.33	(3.21)	4.26	(3.22)	4.32	(3.09)
Perceived Norms	15.27	(9.27)	13.67	(6.69)	12.85	(6.46)
3-month Follow-Up						
Variable	PNF Mean (SD)		PSCF Mean (SD)		Attention-Control Mean (SD)	
Drinks Per Week	7.74	(9.04)	7.68	(8.23)	8.00	(6.98)
Drinks past 30 days	28.86	(31.42)	29.84	(36.58)	30.53	(29.51)
Frequency	4.44	(2.29)	4.43	(2.41)	4.71	(1.91)
YAAPST	3.60	(3.44)	3.44	(3.52)	3.84	(3.33)
Perceived Norms	8.97	(5.72)	9.92	(6.15)	11.43	(6.51)
6-month Follow-Up						
Variable	PNF Mean (SD)		PSCF Mean (SD)		Attention-Control Mean (SD)	
Drinks Per Week	7.64	(9.95)	7.68	(8.19)	7.29	(6.86)
Drinks past 30 days	29.86	(42.26)	29.69	(36.57)	28.10	(29.46)
Frequency	4.35	(2.42)	4.45	(2.47)	4.48	(2.16)
YAAPST	2.94	(3.00)	3.54	(3.91)	3.32	(3.18)
Perceived Norms	9.68	(6.14)	9.91	(5.36)	11.28	(7.11)

Note. PNF = Personalized Normative Feedback; PSCF = Personalized Social Comparison Feedback; YAAPST = Young Adult Alcohol Problems Screening Test.

Table 3
Effect sizes (d) for Changes in Outcomes by Intervention Condition and Site at 3- and 6-Month Follow-up

	3-month Follow-Up					6-month Follow-Up				
	Norms	Drinks Per Week	Drinks Past 30 Days	Freq	YAAPST	Norms	Drinks Per Week	Drinks Past 30 Days	Freq	YAAPST
Sex	0.28***	0.19*	0.25**	0.09	-0.01	0.24**	0.15	0.25	0.09	0.17
Baseline Outcome	0.97***	1.58***	1.20***	1.12***	1.52***	0.97***	1.36***	1.20***	1.12***	2.01***
Site 2 vs. Site 1	0.25**	0.29***	0.15	0.15	0.02	0.16	0.21*	0.15	0.15***	0.22
Site 3 vs. Site 1	0.43***	0.40***	0.27**	0.17	-0.01	0.35***	0.32*	0.27**	0.17***	0.17
PNF vs. Control	-0.48***	-0.28**	-0.21**	-0.18*	-0.12	-0.35***	-0.13	-0.21	-0.18	-0.09
PSCF vs. Control	-0.27***	-0.21*	-0.19*	-0.20*	-0.13	-0.23***	-0.03	-0.19	-0.20	0.11
PNF vs. PSCF	0.16	0.19*	-0.02	0.01	0.02	-0.13	-0.10	-0.11	0.00	-0.15

Note. Freq = frequency; YAAPST = Young Adult Alcohol Problems Screening Test; PNF = Personalized Normative Feedback; PSCF = Personalized Social Comparison Feedback.

* $p < .05$

** $p < .01$

*** $p < .001$