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Perceived Norms Mediate Effects of a Brief Motivational Intervention for Sanctioned College Drinkers

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Abstract

The present study is a secondary analysis of a randomized trial of brief motivational interventions (BMIs) for 198 college students sanctioned for alcohol-related violations of school policy (Carey, Henson, Carey, & Maisto, 2009). Using multivariate latent growth curve models, we evaluated theoretically-derived mediators of the observed BMI effect: motivation to change (readiness-to-change, costs and benefits of drinking), and drinking norms (injunctive norms for peers, and descriptive norms for friends, local peers, and national peers). Results provided partial support for mediation by changes in perceptions of descriptive but not injunctive norms, a pattern that varied by gender and norm type. We found no evidence of a mediating role for any of the motivational variables.

The efficacy of brief alcohol risk reduction interventions for college drinkers is well-established, and interventions that contain personalized feedback, normative comparisons, and motivational enhancement components show particular promise (Carey, Scott-Sheldon, Carey, & DeMartini, 2007; Larimer & Cronce, 2007; Walters & Neighbors, 2005). Furthermore, brief interventions achieve significant risk reduction within several types of students, including the general student population, heavy drinkers, and students sanctioned for alcohol violations. To advance knowledge and enhance intervention efficacy, it is important to identify mediators of intervention-induced change (Kraemer, Wilson, Fairburn, & Agras, 2002). Identification of active ingredients of brief interventions may result in more efficient and cost-effective formats.

Research has yet to clarify how and why multi-component brief motivational interventions (BMIs) change drinking behavior. Relatively few tests of mediation have been reported in the literature. Potential mediators of the BMI effect can be derived from the theories informing the development of these interventions. Potential candidates include (a) enhancing motivation to change and (b) reducing perceptions of normative drinking.

With regard to motivational mechanisms, the Transtheoretical Model of Change (Prochaska, DiClemente, Norcross, & Goldfried, 1992) suggests that successful interventions move

drinkers from Precontemplation or Contemplation towards the Preparation and Action stages of change. Stage-based conceptualizations of motivation have received criticism, however, and some suggest that continuous measures of readiness-to-change may be more sensitive measures for outcome and mediation analyses (Budd & Rollnick, 1996; Sutton, 2001). Although BMIs are designed explicitly to increase motivation to change, few formal tests of this notion can be found in the college drinking intervention literature. Two recent studies operationalized motivation using the Contemplation Ladder, a continuous rating of readiness for change. Wood, Capone, Laforge, Erickson, and Brand (2007) evaluated a BMI intervention with student volunteers; although increases in motivation predicted less drinking, the BMI did not lead to change in motivation. Barnett, Murphy, Colby, and Monti (2007) compared BMI to a computerized alcohol education program with students sanctioned for alcohol policy violations; these investigators reported increases in motivation in both the BMI and comparison conditions, and the lack of group differences precluded mediation analyses.

Alternative markers of motivational change include perceptions of the costs and benefits of drinking, the magnitude of which progresses in predictable fashion across stages of change (Prochaska, 1994; Prochaska, et al., 1994). Thus, we hypothesize that theoretical mediators of BMI-induced change include three motivational variables: readiness-to-change, and perceived costs of drinking, and perceived benefits of drinking.

With regard to normative perceptions, Social Norms Theory (Perkins, 2003) suggests that downward adjustment of elevated norms is a mechanism of change. Relevant norms include beliefs about how much other students drink (i.e., descriptive norms) and beliefs about the degree to which other students approve of drinking (i.e., injunctive norms). Interventions composed primarily of personalized normative feedback have produced significant changes in drinking behavior (e.g., Agostinelli, Brown, & Miller, 1995; S. E. Collins, Carey, & Sliwinski, 2002; Murphy, et al., 2004). Studies with volunteer students receiving feedback-based interventions provide evidence for the mediational role of descriptive norms (Borsari & Carey, 2000; Neighbors, Larimer, & Lewis, 2004; Wood et al., 2007). However, there is no evidence that such interventions change perceptions of peer drinking in sanctioned students, a subset with elevated levels of consumption and problems (cf. Barnett et al., 2007). Furthermore, the relevance of injunctive norms as a mechanism for change in BMIs has not yet been evaluated, despite evidence of their predictive validity in high-risk samples (Larimer, Turner, Mallett, & Geisner, 2004). Therefore, additional hypothesized mechanisms of BMI-induced change include perceived local injunctive norms, and perceived descriptive norms for 3 peer groups that vary in proximity to the individual: close friends, local university students, and US college students.

In sum, both the Transtheoretical Model and Social Norms Theory offer guidance for the mechanisms whereby BMI components may produce reductions in high risk drinking. In this paper, we provide a secondary analysis of data reported by Carey et al. (2009); these data allow us to explore the extent to which the interventions produce change on the theory-based mechanisms, and the extent to which such change mediates the observed intervention effects on alcohol consumption and consequences.

Carey and colleagues (2009) conducted a randomized controlled trial of two forms of brief alcohol risk reduction interventions. Participants were students who violated campus alcohol policy and were required to engage in an alcohol intervention as part of their sanction. The 198 students who consented to be randomized received either a counselor-administered BMI or an interactive computer-administered alcohol education program. Both male and female students who received the BMI reported reduced drinking at one-month relative to baseline, whereas no significant reduction in consumption was associated with exposure to the

computer-based intervention. Gender moderated response to intervention, such that women were significantly more improved after the BMI (relative to the computerized intervention) on all measures of consumption and problems. For all students, drinking returned to baseline levels by the end of the follow-up year.

The first objective of the present study was to evaluate the role of variables representing motivation to change as mediators of the BMI effect. We expected that BMI would increase motivation to change and perceptions of the costs of drinking, as these are addressed by BMI content, and these changes would at least partially explain the effect of BMI on outcomes. We did not expect that the BMI would affect perceptions of the benefits of drinking, because they are not challenged by the BMI. The second objective of the present study was to evaluate the role of perceived descriptive and injunctive norms as mediators of the BMI effect. We expected that BMIs would decrease perceptions of descriptive norms at the local and national levels, because direct feedback on these dimensions is provided in the BMI, and these changes would at least partially explain the BMI effect. We made no predictions for perceptions of close friends drinking, or for perceived approval for excessive drinking (injunctive norms), as these were not subject to normative feedback.

Method

Participants

Students who had violated campus alcohol policy (with no drug involvement) were referred to the research team if it was their first disciplinary sanction; 198 of 269 (75%) eligible students agreed to participate. Participants included male (54%) and female (46%) students; they were predominantly white (91%), underclassmen (freshmen 56%, sophomores 39%), and unaffiliated with Greek social organizations (78%). Mean age was 19.17 ($SD = .71$).

Outcome Measures

Baseline measures covered the month prior to and including the referral event. Follow-up assessments covered the month prior to the day of assessment. For all assessments, a standard drink was defined as a 12 oz. can or bottle of 4–5% beer, 4 oz. glass of 12% table wine, 12 oz. bottle or can of wine cooler, or 1.25 oz. shot of 80 proof hard liquor either straight or in a mixed drink.

Alcohol use variables—Six outcome variables were obtained from a modified version of the Daily Drinking Questionnaire (R. L. Collins, Parks, & Marlatt, 1985): (a) drinks consumed during a typical week, (b) number of drinking days during a typical week, (c) BAC for a typical drinking occasion, (d) peak BAC, (e) drinks consumed in the heaviest week, and (f) frequency of heavy drinking in the past month, defined as 5 or more drinks for men and 4 or more drinks for women (Wechsler, Davenport, Dowdall, Moeykens, & Rimm, 1995).

The last outcome measure was the summary score from the Rutgers Alcohol Problems Index (RAPI; White & Labouvie, 1989). Coefficient alpha for the RAPI was .84 in this sample.

Mediator Variables

Motivation—Readiness-to-change was measured by the Contemplation Ladder (Beiner & Abrams, 1991), an 11-point continuous scale that corresponds to precontemplation (0 = No thought of changing) through contemplation (5 = Think I should change, but I'm not quite ready) and action (10 = Taking action to change). Benefits and costs of drinking were measured by the Decisional Balance for Immoderate Drinking (DBID; Migneault, Velicer, Prochaska, & Stevenson, 1999). This 20-item scale, developed for use with college students,

requires participants to respond to each item with regard to how important it is in their decisions to drink on a 5-point Likert scale (1=not at all important, 5=extremely important). Two 10-item subscales (Pros, Cons) were derived and cross-validated with factor analytic techniques; the scales correlate predictably with alcohol consumption and problem variables and stage of change. Alpha in this sample for pros was .86 and for cons was .80.

Drinking norms—A modified version of the item set used by Larimer and colleagues (Larimer et al., 2001) served as the measure of perceived injunctive norms. It consists of 10 items following the stem “How would your friends respond if they knew ...”; such as “You drank alcohol every weekend,” and “You drank alcohol enough to pass out.” Response options range from 1 (strong disapproval) to 7 (strong approval); alpha for this scale was .82.

Three descriptive norms estimates were from three sets of 7-day grids (Baer, Stacy, & Larimer, 1991) that yielded average daily estimates for (a) close friends of the same gender, (b) the typical student of the same gender at their university, and (c) the typical university student of the same gender in the US. Norms were gender-matched because the “typical” student tends to be perceived as male (Lewis & Neighbors, 2006), and gender-matched feedback is more effective for female students (Lewis & Neighbors, 2007). Thus, drinks per week were estimated across gender-matched reference groups that varied in proximity to the participant.

Procedure

As described in detail elsewhere (Carey et al., 2009), referred students were invited to fulfill their sanction requirement by participating in a research study designed to evaluate two alcohol-related interventions. Students were told that participation through the 1-month follow-up would fulfill the sanction, and they could earn \$20 and \$25 for participating in the 6- and 12-month follow-ups, respectively. Those who did not choose the research option received the standard University sanction (AlcoholEdu for Sanctions™).

All participants provided written consent and contact information, and completed the baseline assessment. They were then randomly assigned by gender to receive either Alcohol 101 Plus™ ($n = 99$) or the BMI ($n = 99$) and received an appointment for their intervention, which usually took place within one week.

The BMI used by Carey and colleagues (2009) involved an initial alcohol use assessment followed by a semi-structured intervention session. In this session, the interventionist provided personalized feedback with gender-specific comparisons to national and local consumption norms; and discussed perceptions of peer drinking behavior, BAC and alcohol's effect on the brain, and feedback about negative consequences, alcohol-related driving and sexual risks. Next, the interventionist discussed harm reduction or harm prevention, provided a menu of protective strategies, and encouraged goal setting and collaborative development of change plans to reduce alcohol consumption or otherwise reduce the risk of harm. Clinical psychology or counseling graduate students implemented the manualized protocol in motivational interviewing style (Miller & Rollnick, 2002), a directive but client-centered counseling style that helps the student to explore ambivalence about drinking and to identify personalized reasons for change. The BMI sessions lasted an average of 50 minutes ($SD = 13.11$; range 25–100 minutes).

Alcohol 101 Plus™ is an interactive program that allows students to explore alcohol-related issues across a “virtual campus,” engage in social decision making at a virtual party, and learn about factors affecting their own BAC in a virtual bar. Students navigated through the

program at their own pace in a private office; they had to spend at least 60 minutes and none opted for more.

After the intervention session, students completed post-intervention ratings and returned them in sealed envelopes to preserve confidentiality of evaluations. Nearly all students (97%) completed a 1-month follow-up assessment.

Analysis Plan

Because the research by Carey and colleagues (2009) demonstrated significant intervention effects for short-term outcomes only, mediation analyses were conducted using the baseline and 1-month data. Only 6 individuals were missing data at the 1-month follow-up; to retain as much information as possible, these missing cases were imputed using EM imputation implemented in Mplus (ver. 5.2; Muthén & Muthén, 2008).

Multivariate latent growth curve models (MLGM) are an optimal framework for testing mediation longitudinally (Cheong, MacKinnon, & Khoo, 2003; Duncan, Duncan, & Strycker, 2006), because MLGMs model longitudinal change simultaneously across multiple variables while allowing one change process to predict another (see Figure 1). This research used a variant of a Curve-of-Factor Model (Duncan et al., 2006), which combines a latent growth curve model with alcohol consumption factors derived through factor analysis, to account for the shared relationships and measurement error among the drinking variables. As depicted in the left side of Figure 1, the Typical Drinking factor was comprised of typical drinks per week, typical number of drinking days, and typical BAC; the Heavy Drinking factor was comprised of the drinks per heaviest week, number of heavy drinking episodes, and peak BAC. The mediators were each examined individually to identify unique effects. In accordance with Duncan et al., factor loadings for each item were held invariant across time and intercepts were fixed to 0.

The MLGM combines the mediator growth curve model to the alcohol factor growth curve model. This model decomposes change for each person into *baseline* drinking and mediator scores, represented by the baseline drinking and mediator factors, and baseline to 1-month *change scores* for the drinking and mediator variables, represented by the 1-month change in drinking and mediator factors, respectively. Although the baseline drinking and mediator factors are not of primary interest to this research, they are a byproduct of the standard MLGM. Because these growth models use only two time points, the mediator measurement error variances and the drinking factor variances must be fixed to 0 for proper model identification. Thus, the mediator Baseline and 1-Month Factors should not be interpreted as truly latent (controlling for measurement error) as is the case with the alcohol factors; instead, they are equivalent to the raw baseline scores and raw difference scores, respectively.

As shown in Figure 1, Path A describes intervention differences in the baseline to 1-month decrease in drinking behaviors holding the mediator constant. When the type of intervention predicts differential changes in the mediator (Path B) and differential changes in the mediator predict differential changes in drinking behaviors (Path C), mediation is established. An advantage to testing mediation via MLGM is that mediation can be tested in one step rather than through the traditional series of four steps outlined by Baron and Kenny (1986). Specifically, by fitting the model depicted in Figure 1, one can characterize mediation through the product of Paths B and C, which is called the indirect effect (MacKinnon, Krull, & Lockwood, 2000). If Path A is non-significant and there is a significant indirect effect, the mediator fully mediates the intervention effect. Mplus 5.2 was used to fit all MLGM models as well as to estimate the indirect effects and 95% confidence intervals using Maximum Likelihood Estimation with robust standard errors.

Each mediator was examined independently, and intervention status was coded '0' for Alcohol 101 plus and '1' for BMI. To examine the concurrent validity through patterns of results across similar drinking outcomes, separate models were estimated and compared for the Typical Drinking factor, the Heavy Drinking factor, and for alcohol consequences (i.e., RAPI score). This yielded 21 distinct MLGM mediation models to be estimated: 7 potential mediators by 3 drinking variables. Effect sizes were reported as the proportion of explained variance (i.e., R^2) for both the mediators and the drinking variables.

A final consideration in the analysis plan was the finding of gender differences with respect to intervention efficacy in the Carey et al. (2009) study. Therefore, MLGM models were fit separately for men and women, and gender moderation effects were examined using methods outlined by Preacher and Hayes (2008) to determine if the estimated indirect effects differ significantly between men and women.

Results

Tables 1 and 2 list the means and standard deviations by intervention condition for the baseline and one-month data for men and women, respectively. Groups did not differ on any demographic or drinking variables, or on any of the proposed mediators at baseline.

Primary Mediation Analyses

Overview—Tables 3 and 4 relate the mediation results for men and women, respectively, where effects significant at $\alpha = .05$ are marked with asterisks. Significant mediation requires a significant indirect effect, indicated by a 95% confidence interval that does not include zero. Standardized indirect effect statistics appear in Column 4 in Tables 3 and 4, followed by the lower and upper bound of the 95% confidence interval. The first column of Tables 3 and 4 relates the intervention direct effect on drinking behaviors holding the mediator constant, such that the numerical values describe the *difference* between the baseline to 1 month change in drinking between the BMI and Alcohol 101 conditions (i.e., time X condition interaction). For example, from Table 3, the average reduction in drinking for men in the BMI condition was .41 (Path A) standardized factor units lower than men in the Alcohol 101 condition holding any mediating effects of readiness-to-change constant, and this difference was significant. Tables 3 and 4 reveal that the BMI had significantly greater effects on both Typical and Heavy Drinking factors, independent of all proposed mediators, for both men and women. The second column (Path B) describes the intervention effect on changes in the hypothesized mediator. In the third column, Path C describes the degree to which changes from baseline to 1 month in the mediator predict baseline to 1-month changes in drinking, independent of intervention type.

Readiness-to-change—As shown in Tables 1 and 2, scores on the Contemplation Ladder did not change over time. The intervention condition exhibited no relationship to baseline to 1-month change in readiness-to-change for men or women (i.e., Tables 3 and 4; Path B); therefore, mediation was not possible. All estimated indirect effects were indistinguishable from zero.

Pros of drinking—Similarly, there were no differential intervention effects on changes in perceived pros of drinking for men or women, so mediation was not possible. Increases in perceived pros of drinking were associated with more heavy drinking for men and more alcohol problems for women (Path C), but this relationship was unrelated to intervention, and did not result in group increases over time (means presented in Tables 1 and 2).

Cons of drinking—For men, there was no significant intervention effect on changes to perceived cons of drinking, consistent with no significant changes over time. Women, in contrast, did exhibit a significant intervention effect; women in the BMI condition decreased their cons score approximately .33 standard units more than women in the Alcohol 101 condition, who did not change their perceived cons of drinking over time (see means in Table 2). Further, intervention status explained 11% of the variance in the change in perceived cons of current drinking for women. However, changes in perceived cons to current drinking did not relate to behavioral changes (Table 4; Path C), so there were no significant mediating effects.

Injunctive norms: friends' approval—No significant intervention effects were observed on changes in perceived friends' approval of drinking for either men or women; therefore, mediation was not possible. Means reported in Tables 1 and 2 show that perceptions of friends' approval did not change over time for either men or women.

Descriptive norms: friends—For men, the interventions did not produce a differential effect on change in perceived friends' drinking (Table 3; Path B), precluding mediation. However, women did exhibit significant intervention differences in changes in friends' drinking, such that women in the BMI condition reported a decrease of $-.31$ standard units in perceptions of friends' drinking over women in the Alcohol 101 condition (see Table 4, Path B). Intervention status explained 9% of the variance in the change of friends' drinking for women. Moreover, for both men and women, changes in friends' drinking were significantly associated with changes in the participant's drinking across both drinking factors (Path C) and with men's RAPI score. Thus, for women, significant indirect effects suggest that friends' drinking fully mediated the BMI-induced changes in Typical Drinking and partially mediated Heavy Drinking (because Path A remained significant for this outcome).

For men, intervention status and changes in perceived friends' drinking explained 44% of the variance of changes in the Typical Drinking factor, 31% of changes in the Heavy Drinking factor, and 13% of changes in RAPI scores. For women, intervention status and changes in reported friends' drinking explained 35% of the variance of changes in the Typical Drinking factor, 22% of changes in the Heavy Drinking factor, and 2% of changes in RAPI scores.

Descriptive norms: local—Both men and women exhibited significant intervention effects on perceived drinking of local peers, such that reductions in estimated standardized peer drinks per week associated with the BMI condition were .36 (for men) and .34 (for women) greater than the Alcohol 101 condition. Intervention status explained 13% of the variance in change in peers' drinking for men and 11% for women. Further, changes in local norms were significantly associated with behavioral change for men (Table 3; Path C), yielding significant mediating effects for all drinking variables. In contrast, changes in local norms were not associated with behavior change for women (Table 4; Path C), precluding mediation.

For men, intervention status and changes in local norms explained 18% of the variance of changes in the Typical Drinking factor, 24% of changes in the Heavy Drinking factor, and 8% of changes in RAPI scores. For women, intervention status and changes in local norms explained 13% of the variance of changes in the Typical Drinking factor, 17% of changes in the Heavy Drinking factor, and 2% of changes in RAPI scores.

Descriptive norms: national—Significant intervention effects were achieved for both men and women on perceptions of student drinking across the nation, such that individuals in the BMI condition reported reductions in standardized national norms of .38 (men) and .

33 (women) drinks per week more than individuals in the Alcohol 101 condition. Intervention status explained 14% of the variance in change in typical drinking for men and 11% for women. Further, change in national norms was inconsistently associated with behavior change. Specifically, for men, change in national norms predicted changes in the Typical Drinking factor; however, for women, change in national norms were not related to any of the drinking outcomes. Therefore, changes in national norms partially mediated the intervention effect on Typical Drinking for men.

For men, intervention status and changes in national norms explained 19% of the variance of changes in the typical drinking factor, 16% of changes in the heavy drinking factor, and 4% of changes in RAPI scores. For women, intervention status and changes in national norms explained 11% of the variance of changes in typical drinking, 16% of changes in heavy drinking, and 2% of changes in RAPI scores.

Gender Comparisons

For the significant mediators, additional analyses were conducted to determine if the mediating effects differed between men and women. Specifically, the female indirect effect was subtracted from the male indirect effect as a contrast. If the 95% confidence interval of the contrast contains '0', then the mediating effects do not significantly differ across men and women. Of the 4 significant mediating effects for men and 2 mediating effects for women, none of the mediating effects differed significantly across gender.

Discussion

The purpose of this research was to examine several hypothesized mechanisms for the BMI-related change observed by Carey et al. (2009). The pattern of results provides partial support for mediation by changes in perceptions of descriptive norms; we did not find evidence for the explanatory value of injunctive norms or for motivational variables.

The primary findings indicate that changes in descriptive drinking norms either fully or partially mediated the effect of the BMI relative to the computerized intervention on several outcomes, adding to a growing body of evidence that reducing perceptions of exaggerated descriptive norms is an active ingredient of brief interventions tailored to college drinkers. Mediation by descriptive norms has been demonstrated in multi-component BMIs delivered in face-to-face format (Borsari & Carey, 2000, Wood et al., 2007), as well as when the intervention consists primarily of computer-administered personalized normative feedback (e.g., Lewis & Neighbors, 2007; Neighbors et al, 2004; Walters, Vader, & Harris, 2007). Evidence provided by the current study, as well as a recent study using a web-based intervention (Doumas, McKinley, & Book, 2009), confirms that changes in descriptive norms mediate outcomes even when students have been mandated to receive an intervention. Taken together, reductions in perceived drinking norms appear to be a robust active ingredient of alcohol risk reduction interventions containing personalized normative feedback in college samples.

Although Alcohol 101 Plus does include some content related to national norms, our data indicate that students are not acquiring or retaining this information as well as they are in the BMI. This may be a case where the self-directed navigation features designed into Alcohol 101 Plus may not be optimal; if students do not choose to view components containing normative comparisons, they may be missing important content. Indeed, unpublished data from our lab suggest that the national norms contained within the Alcohol 101 Plus program are contained in a location accessed infrequently by students. In contrast, all participants who received a BMI discussed both local university and national gender-specific norms for drinks per week, and local gender-specific norms for heavy drinking frequency; they also

received feedback regarding gender-specific percentiles relative to national and local norms for drinks per week. Thus, it is likely that BMI participants received more normative feedback and processed it more deeply than did Alcohol 101 participants.

The function of descriptive norms varied by norm type and by gender. The BMI was more effective than Alcohol 101 in changing women's understanding of all forms of descriptive norms (friend, local, and national). Despite strong evidence of a downward adjustment of normative perceptions for all comparison groups, only changes in *friends'* drinking satisfied criteria for mediation by producing significant indirect effects of BMI on women's drinking at follow-up. These results suggest that women's behavior may be less influenced by more abstract normative information, such as the "average" female student's behavior, and more influenced by the drinking of female friends. It is worth noting that the BMI protocol did not explicitly address friends' drinking behavior. Thus, it is not obvious why participation in a BMI produced a reduction in friend norms for women. Female students apparently generalized the normative information provided for peers to friends, and the lowered norms attributed to friends were associated with risk reduction. Future research is needed to explain this finding.

For male students, the BMI was more effective than Alcohol 101 in changing perceptions of the drinking habits of local and national male peers but not of their friends. Local peer norms mediated BMI effects for men across both typical and heavy drinking and problems, whereas national norms mediated typical drinking only. More so than women, men appear to be sensitive to normative information about the "average" male student at the same university that is uniquely imparted by the BMI. At least one study documented stronger relationships between local peer norms and drinking and consequences for men than for women (Read, Wood, Davidoff, McLacken, & Campbell, 2002). In addition, evidence suggests that normative pressures to drink may be greater for male students than for female students (Suls & Green, 2003). Modeling studies reveal that men match the drinking rates of same-gender strangers (e.g., Collins, Parks, & Marlatt, 1985); thus males may be susceptible to social influence from other male drinkers that are not their friends. Unlike female participants, males who received the BMI did not differentially change perceptions of the drinking behaviors of their male friends.

For both male and female students, change in perceived friends' drinking was the strongest predictor of drinking reduction, relative to changes in local or national norms. These findings confirm the important socialization role of the immediate social environment for drinking among emerging adults (Bourgeois & Bowen, 2001; McCabe, Hughes, Bostwick, & Boyd, 2005; Reifman, Watson, & McCort, 2006). Reifman and colleagues (2006) demonstrated that college students engage in an active selection process in the choice of their peer groups through changes in the overall drinking risk of a student's social network over time, which occurred primarily by the addition or deletion of heavy drinking peers. The data from our study are consistent with either a downward adjustment of perceptions of friends' drinking or a focus on lighter drinking individuals as close friends between the baseline and 1-month assessments.

Normative information about the drinking of an average U.S. student was infrequently and inconsistently related to behavior change for both men and women. Related effect sizes were all small or trivial in the prediction of behavior change. Relative to local university norms (for male students) and friend norms (for female students), these distal normative comparisons appear less likely to motivate behavior change. Given that proximal norms have stronger relationships with drinking behavior than more distal norms (e.g., Yanovitsky, Stewart, & Lederman, 2006), future interventions should use local norms when available.

This study extends the literature on the mediational role of norms by measuring injunctive norms (beliefs about how positively or negatively one's friends would evaluate one's drinking). Injunctive norms did not change over time, and neither intervention altered perceptions of friends' approval of drinking. Possible explanations include the fact that neither intervention explicitly challenged injunctive norms, or insensitive measurement. Our findings reveal that descriptive norms can be reduced significantly without concurrent change in perceived injunctive norms.

The potential for BMIs to incorporate personalized normative feedback regarding peer approval of risky drinking (i.e., injunctive norms) has yet to be tested. Schroeder and Prentice (1998) designed an intervention that presented student drinkers with evidence that they overestimated peer approval of drinking and discussed the phenomenon of pluralistic ignorance (i.e., that despite engaging in heavy drinking, not all peers are comfortable with these behaviors). Their intervention reduced drinking relative to control intervention up to six months post-intervention. Prentice (2008) has argued that the function of feedback on injunctive norms is not to relocate the norm (as it may be difficult to provide convincing evidence that challenges perceptions of peer approval), but rather to weaken its influence by challenging its uniformity. To date, BMIs have been designed to provide personalized normative feedback exclusively using descriptive norms. It remains an empirical question whether BMIs including components that challenge injunctive norms might facilitate behavior change.

Initially we had predicted that measures of motivation to change would mediate the effects of BMIs, which are designed to help students to resolve ambivalence about current drinking in the direction of risk reduction. However, none of the motivational variables met criteria for mediation. For the men, there were no intervention effects on readiness-to-change nor on the pros or cons of drinking; change in these variables had no effect on change in drinking. One explanation for this finding is that readiness-to-change was measured at baseline (before the intervention) and 1-month after the intervention. If the intervention had an immediate effect on motivation, increased readiness-to-change might only be detected immediately following the intervention. One month following the intervention, if most of the behavior change has been achieved, participants may have returned to a lower level of interest in change.

No evidence of mediation by motivational variables was obtained in the subset of women. However, an unexpected finding emerged for women with regard to the perceived costs of drinking. Women in the BMI condition reported *lower* perceived costs to drinking than women in the Alcohol 101 condition. Although the BMI decreased perceived costs of drinking, this was not associated with any increase or decrease in alcohol consumption. In contrast, students expressing greater perceived benefits to drinking from baseline to 1-month follow-up (though unrelated to intervention condition) reported more alcohol-related problems (females) and heavy drinking (males). This provides some evidence for the validity of decisional balance as a measure of motivation (cf. Prochaska et al., 1994) but raises questions about the clinical utility in trying to change perceived pros and cons of drinking.

This study did not support readiness-to-change as a mechanism for BMI efficacy. Consistent with this finding, a recent report by Borsari, Murphy, and Carey (2009) reanalyzed data from three separate trials of BMIs with student volunteers, all of which used the Readiness to Change Questionnaire (RTCQ; Rollnick, Heather, Gold, & Hall, 1992); in none of the three studies were all criteria for mediation met. Thus, contrary to the theory informing BMIs, change in measures of motivation are not consistently associated with reductions in drinking behavior (Borsari et al., 2009, Studies 1 and 2) and participation in BMIs is not

consistently associated with change in motivation (Borsari et al., 2009, Study 2; Wood et al., 2007). It is possible that the measures of readiness-to-change used in these studies (i.e., the contemplation ladder and the RTCQ) do a poor job of assessing the construct in this population. Perhaps an alternative measure crafted specifically for young adult drinkers who do not intend to quit drinking (see Carey & Hester, 2005) can provide a more sensitive measure of readiness-to-change. Also, if motivation to reduce drinking is reactive to recent behavior patterns or person-situation transactions, then alternate models of measurement may be needed to detect its influence on behavior change.

Strengths, Limitations, and Conclusions

This study tested several hypothesized mechanisms of behavior change in the context of a randomized, controlled clinical trial. Potential mediators were derived from theory and represented specific components (i.e., motivation and norms) that distinguish BMIs from other interventions. When evidence of mediation was found, replication was established using multiple dimensions of drinking behavior. Furthermore, this study helps to establish changes in norm perception as a mediational process in college student drinkers that generalizes across interventions administered in both voluntary and mandated circumstances.

However, several limitations should be noted. First, although the data are longitudinal, the timing of the assessments was less than optimal for detecting mediational mechanisms (Nock, 2007). We may draw causal conclusions regarding intervention effects on changes in the mediator and on drinking behaviors, but we cannot make the same claim about relationships between the mediators and drinking behaviors. It is possible that the reported changes in descriptive norms are a consequence, rather than a cause, of the participants' altered behavior. Second, some potential mediators, such as readiness-to-change, might have been assessed more precisely if measurements were taken immediately following intervention. More frequent assessment in the time immediately following intervention would allow for more complex latent variable methods to better characterize intervention outcomes relative to hypothesized mediators (Stout, 2007). A third limitation relates to sample size. Because Carey et al. (2009) demonstrated differential intervention effects across gender, we built separate models for men and women, which effectively halved our sample and limited power to detect small effects. Replication with a larger sample would provide valuable confirmation of these findings.

The efficacy of BMIs is explained in part by changes in students' perceptions of what is normative drinking. The intervention had significant indirect effects on outcomes for women through perceptions of female friends' drinking, and for men through perceptions of how both local and national male peers drink. Future interventions may be made more efficacious by targeting the nature of normative feedback to gender. Social Norms Theory holds that exaggerated norms create an environment conducive to risky drinking; these data provide further support that interventions designed to reduce elevated descriptive norms result in lowered levels of drinking across multiple drinking outcomes. Furthermore, these and other findings call into question the relevance of motivational mechanisms of change in alcohol interventions designed for college drinkers.

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Table 1

Baseline and 1-month raw means (SD) of alcohol use and mediator variables by intervention condition, men only ($N = 107$).

	Alc101		BMI	
	Baseline $n = 53$	One-month $n = 50$	Baseline $n = 54$	One-month $n = 52$
Alcohol Use and Problems				
Drinks in Typical Week	18.91 (16.76)	15.47 (11.14)	16.43 (11.56)	14.62 (11.50)
Drinking Days per Week	3.02 (1.56)	2.78 (1.25)	2.98 (1.49)	2.83 (1.63)
Typical BAC	0.10 (0.08)	0.08 (0.06)	0.08 (0.05)	0.06 (0.05)*
Drinks in Heaviest Week	27.24 (23.01)	22.14 (17.03)	24.09 (18.08)	19.23 (15.17)*
Heavy Drinking Frequency	6.78 (6.11)	5.10 (4.62)	6.07 (4.89)	4.76 (4.58)*
Peak BAC	0.19 (0.13)	0.15 (0.10)	0.14 (0.09)	0.11 (0.07)*
RAPI Score	4.94 (4.44)	5.04 (6.73)	5.52 (6.85)	4.48 (5.15)
Hypothesized Mediators				
Contemplation Ladder	3.20 (2.86)	3.58 (3.21)	3.00 (2.63)	3.79 (3.06)
DBIM – cons	26.14 (5.90)	26.60 (5.53)	26.54 (5.72)	27.44 (5.66)
DBIM – pros	31.27 (6.47)	30.08 (7.36)	31.22 (7.04)	31.39 (7.29)
descriptive norms - national	22.52 (11.47)	20.44 (10.30)	23.75 (8.99)	14.71 (7.66)*
descriptive norms - local	22.08 (10.69)	21.40 (10.32)	23.16 (9.39)	16.16 (7.27)*
descriptive norms – friends	24.65 (15.53)	21.06 (12.39)	24.00 (11.48)	20.61 (11.64)*
injunctive norms	3.12 (0.60)	3.15 (0.76)	3.24 (0.63)	3.20 (0.62)

Note. BAC = blood alcohol concentration. RAPI = Rutgers Alcohol Problems Index. DBIM = Decisional Balance for Immoderate Drinking. Alc101 = Alcohol 101 Plus. BMI = brief motivational intervention.

No significant baseline differences on any of the variables.

Significant within-group reduction from baseline to one-month change ($p < .01$) marked by asterisks.

Table 2

Baseline and 1-month raw means (SD) of alcohol use and mediator variables by intervention condition, women only ($N = 91$).

	Alc101		BMI	
	Baseline $n = 46$	One-month $n = 46$	Baseline $n = 45$	One-month $n = 44$
Alcohol Use and Problems				
Drinks per Week	11.55 (9.21)	10.83 (8.95)	12.82 (9.93)	7.93 (6.15)*
Drinking Days per Week	2.85 (1.52)	2.63 (1.16)	2.98 (1.75)	2.18 (1.17)*
Typical BAC	0.10 (0.10)	0.08 (0.06)	0.10 (0.06)	0.08 (0.05)*
Drinks in Heaviest Week	17.43 (17.87)	15.20 (12.30)	17.62 (12.34)	11.46 (9.13)*
Heavy Drinking Frequency	4.32 (4.53)	4.11 (4.56)	5.79 (4.89)	3.05 (3.27)*
Peak BAC	0.17 (0.09)	0.15 (0.09)	0.18 (0.10)	0.13 (0.11)*
RAPI Score	5.11 (6.66)	4.00 (5.67)	4.71 (5.32)	2.55 (2.63)*
Hypothesized Mediators				
Contemplation Ladder	3.16 (2.91)	3.41 (3.07)	3.41 (3.13)	4.44 (3.59)
DBIM –cons	25.98 (5.77)	26.72 (5.47)	26.34 (5.85)	24.57 (6.09)*
DBIM - pros	30.46 (5.36)	30.52 (6.10)	28.68 (6.03)	29.22 (5.51)
descriptive norms - national	18.22 (8.24)	15.88 (6.63)	19.02 (10.25)	11.49 (8.13)*
descriptive norms - local	16.70 (7.72)	16.84 (8.06)	18.49 (9.11)	12.92 (7.33)*
descriptive norms – friends	14.98 (9.19)	15.36 (9.55)	17.34 (9.42)	13.48 (7.71)*
injunctive norms	2.82 (0.71)	2.82 (0.76)	2.76 (0.62)	2.79 (0.74)

Note. BAC = blood alcohol concentration. RAPI = Rutgers Alcohol Problems Index. DBIM = Decisional Balance for Immoderate Drinking. Alc101 = Alcohol 101 Plus. BMI = brief motivational intervention.

No significant baseline differences on any of the variables.

Significant within-group reduction from baseline to one-month change ($p < .01$) marked by asterisks.

Table 3

Standardized mediating and indirect effects, men only ($N = 107$).

	Intervention Effect on Drinking (Path A)	Intervention Effect on Mediator (Path B)	Mediator's Effect on Drinking (Path C)	Estimated Indirect Effect	Lower Bound for 95% CI	Upper Bound for 95% CI
<i>Readiness-to-change: Contemplation Ladder</i>						
Typical ^a	-0.41*	0.06	0.06	0.00	-0.01	0.02
Heavy ^b	-0.38*	0.07	0.03	0.00	-0.01	0.01
RAPI score	-0.11	0.07	0.16	0.01	-0.02	0.04
<i>Pros of drinking</i>						
Typical ^a	-0.42*	0.11	0.14	0.02	-0.01	0.04
Heavy ^b	-0.40*	0.11	0.14*	0.02	-0.02	0.04
RAPI score	-0.11	0.11	0.11	0.01	-0.01	0.04
<i>Cons of drinking</i>						
Typical ^a	-0.41*	0.00	0.00	0.00	0.00	0.00
Heavy ^b	-0.39*	0.00	0.05	0.00	-0.01	0.01
RAPI score	-0.11	0.00	-0.04	0.00	-0.01	0.01
<i>Injunctive Norms: friends' approval</i>						
Typical ^a	-0.40*	-0.04	0.13	-0.01	-0.03	0.02
Heavy ^b	-0.37*	-0.04	0.07	0.00	-0.02	0.01
RAPI score	-0.09	-0.04	0.03	0.00	-0.01	0.01
<i>Descriptive Norms: friend</i>						
Typical ^a	-0.29*	-0.03	0.59*	-0.02	-0.13	0.10
Heavies ^b	-0.33*	-0.02	0.44*	-0.01	-0.10	0.08
RAPI score	-0.10	-0.01	0.35*	0.00	-0.08	0.07
<i>Descriptive Norms: local</i>						
Typical ^a	-0.29*	-0.36*	0.30*	-0.11*	-0.21	-0.01

	Intervention Effect on Drinking (Path A)	Intervention Effect on Mediator (Path B)	Mediator's Effect on Drinking (Path C)	Estimated Indirect Effect	Lower Bound for 95% CI	Upper Bound for 95% CI
Heavy ^b	-0.28 [*]	-0.36 [*]	0.24 [*]	-0.08 [*]	-0.15	-0.02
RAP1 score	0.00	-0.35 [*]	0.28 [*]	-0.10 [*]	-0.22	-0.02
<i>Descriptive Norms: national</i>						
Typical ^a	-0.32 [*]	-0.38 [*]	0.20 [*]	-0.08 [*]	-0.15	-0.01
Heavy ^b	-0.32 [*]	-0.38 [*]	0.16	-0.06	-0.13	0.01
RAP1 score	-0.02	-0.37 [*]	0.19	-0.07	-0.16	0.02

Note. Rows summarize separate models for each outcome variable; blocks represent sets of models testing each of the 7 proposed mediators. Values in the first two columns representing intervention effects are differences in baseline to 1-month change between Alc101 (coded 0) and BMI (coded 1). CI = confidence interval. RAP1 = Rutgers Alcohol Problems Index.

^aTypical Drinking Factor.

^bHeavy Drinking Factor.

Asterisks signify values that are significant at $p < .05$.

Table 4

Standardized mediating and indirect effects, women only ($N = 91$).

	Intervention Effect on Drinking (Path A)	Intervention Effect on Mediator (Path B)	Mediator's Effect on Drinking (Path C)	Estimated Indirect Effect	Lower Bound for 95 % CI	Upper Bound for 95 % CI
<i>Readiness-to-change: Contemplation Ladder</i>						
Typical <i>a</i>	-0.30*	0.14	-0.06	-0.01	-0.04	0.02
Heavies ^b	-0.34*	0.14	-0.16	-0.02	-0.07	0.02
RAPI score	-0.15	0.14	0.06	0.01	-0.02	0.04
<i>Pros of drinking</i>						
Typical <i>a</i>	-0.32*	0.04	0.14	0.01	-0.02	0.04
Heavies ^b	-0.37*	0.04	0.12	0.00	-0.02	0.03
RAPI score	-0.15	0.04	0.18*	0.01	-0.03	0.04
<i>Cons of drinking</i>						
Typical <i>a</i>	-0.35*	-0.33*	-0.13	0.04	-0.02	0.11
Heavies ^b	-0.39*	-0.33*	-0.10	0.04	-0.04	0.10
RAPI score	-0.14	-0.33*	0.02	-0.01	-0.06	0.05
<i>Injunctive Norms: friends' approval</i>						
Typical <i>a</i>	-0.30*	0.04	-0.10	0.00	-0.02	0.02
Heavies ^b	-0.36*	0.04	0.08	0.00	-0.02	0.02
RAPI score	-0.14	0.04	0.08	0.00	-0.01	0.02
<i>Descriptive Norms: friend</i>						
Typical <i>a</i>	-0.20	-0.31*	0.50*	-0.15*	-0.28	-0.02
Heavies ^b	-0.26*	-0.31*	0.32*	-0.10*	-0.19	-0.01
RAPI score	-0.13	-0.30*	0.04	-0.01	-0.06	0.03
<i>Descriptive Norms: local</i>						
Typical <i>a</i>	-0.27*	-0.34*	0.16	-0.05	-0.18	0.07

	Intervention Effect on Drinking (Path A)	Intervention Effect on Mediator (Path B)	Mediator's Effect on Drinking (Path C)	Estimated Indirect Effect	Lower Bound for 95 % CI	Upper Bound for 95 % CI
Heaviest ^b	-0.29 [*]	-0.34 [*]	0.21	-0.07	-0.15	0.01
RAP1 score	-0.15	-0.34 [*]	-0.01	0.00	-0.07	0.08
<i>Descriptive Norms: national</i>						
Typical ^a	-0.30 [*]	-0.33 [*]	0.07	-0.02	-0.09	0.05
Heaviest ^b	-0.33 [*]	-0.33 [*]	0.11	-0.04	-0.11	0.04
RAP1 score	-0.16	-0.32 [*]	-0.06	0.02	-0.04	0.08

Note. Rows summarize paths in separate models for each outcome variable; blocks represent sets of models testing each of the 7 proposed mediators. Values in the first two columns representing intervention effects are differences in baseline to one-month change between Alc101 (coded 0) and BMI (coded 1). CI = confidence interval. RAP1 = Rutgers Alcohol Problems Index.

^aTypical Drinking Factor.

^bHeavy Drinking Factor.

Asterisks signify values that are significant at $p < .05$.