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Protective Behavioral Strategies as a Context-Specific Mediator: A Multilevel Examination of Within- and Between-Person Associations of Daily Drinking

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Abstract

Research indicates that a drinker’s environmental and social context can be differentially associated with drinking outcomes. Further, although many researchers have identified that more frequent use of protective behavioral strategies (PBS) is associated with lower alcohol consumption and negative consequences, scant research has examined how one’s drinking context may promote or hinder PBS use. The present study examined how the context of drinking each day (i.e., where and with whom) is associated with level of consumption and reported alcohol-related problems among n = 284 college drinkers (69.0% female) directly, as well as indirectly through the use of PBS. Two different dimensions of PBS are examined (i.e., “Limits” or limiting consumption, and “Avoidance” or avoiding alcohol in general / specific alcohol situations), as well as their relationship with daily drinking. Moreover, we explored these relationships intra-individually (within-person across time), as well as inter-individually (between people). Daily drinking was assessed using a weekly diary design. Using multilevel structural equation modeling, we found that environmental context (i.e., drinking at a bar or party) is associated with heavier alcohol use directly and indirectly through PBS that involve limiting one’s drinking; these effects occurred only at the daily (within-person) level. Additionally, social context (i.e., drinking with friends) predicts elevated drinking but is unrelated to PBS use. Similar findings were present for alcohol-related problems, controlling for consumption level. College student drinking interventions may benefit from a focus on increasing the use of PBS within potentially risky drinking environments to help reduce problematic alcohol use.
Keywords: college drinking, protective behavioral strategies, environmental context, social context, multilevel SEM

Public Significance Statement:

Findings suggest that some social (i.e., who) and environmental (i.e., where) contexts represent elevated risk for higher alcohol consumption and related problems. Moreover, select types of protective behavioral strategies (PBS) for reducing harm are more effective in some environmental contexts, whereas other contexts are more resistant to using protective behaviors. These findings suggest that college drinking interventions may benefit from focusing on increasing the use of PBS within high-risk drinking environments to help reduce problematic alcohol use.
Disclosures and Acknowledgments

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Protective Behavioral Strategies as a Context-Specific Mediator: A Multilevel Examination of Daily Drinking

Heavy alcohol use is prevalent among college students in the United States with approximately 44% of students engaging in heavy episodic drinking (i.e., consuming 4+/5+ drinks in one sitting for women/men) in the past two weeks (Wechsler & Nelson, 2008). College students who drink heavily are at greater risk for experiencing consequences from drinking, such as academic and occupational problems, unsafe sexual behavior, blacking out from drinking (e.g., White & Hingson, 2013), and past-year alcohol use disorders (Wu, Pilowsky, Schlenger, & Hasin, 2007). Due to the prevalence of heavy drinking on college campuses and potential risks this behavior may incur, efforts to identify factors that contribute to or reduce college students’ alcohol-related harm are critical.

Protective Behavioral Strategies

Protective behavioral strategies (PBS) are one factor related to lower alcohol consumption and negative consequences (e.g., Linden, Lau-Barraco, & Milletich, 2013; Martens, Ferrier, Sheehy, Corbett, Anderson, & Simmons, 2005; see Pearson, 2013 and Prince, Carey, & Maisto, 2013 for reviews). PBS are defined as cognitive-behavioral strategies one can use in or before a drinking situation to limit alcohol use or related harms. Examples include alternating non-alcoholic and alcoholic beverages, avoiding drinking games, and leaving a drinking event at a predetermined time (e.g., Novik & Boekeloo, 2011). More frequent PBS use is associated with fewer heavy episodic drinking episodes (Martens, Pederson, LaBrie, Ferrier, & Cimini, 2007) and lower blood alcohol concentration (BAC; Sugarman & Carey, 2007). Given its relationship to alcohol-related impairment reduction, several college student alcohol intervention programs have included PBS, or other drinking control strategies, as successful skills-training components.
(e.g., Dimeff, Baer, Kivlahan, & Marlatt, 1999). Although interventions that focus exclusively on PBS have not been shown to be efficacious (LaBrie, Napper, Grimaldi, Knapper, & Lac, 2015; Martens, Smith, & Murphy, 2013), PBS has been shown to mediate intervention efficacy for multicomponent interventions that address normative feedback, motivations to drink, and coping skills, among other content (e.g., Barnett, Murphy, Colby, & Monti, 2007; Larimer et al., 2007). These consistent findings suggest that PBS is an important component for reducing problematic alcohol consumption among college students. Extant research examining PBS has not, however, focused on the specific context or conditions under which PBS may be most efficacious.

**Drinking Context**

Research indicates that a drinker’s environmental context can be differentially associated with drinking outcomes. Drinking that occurs most frequently in public places is often related to higher levels of alcohol use and negative outcomes (e.g., Jones-Webb, Toomey, Short, Murray, Wagenaar, & Wolfson, 1997; Rossow, 1996; Single & Wortley, 1993). More specifically, drinking in bars (Single & Wortley, 1993) and at parties (Harford, Wechsler, & Seibring, 2002; Usdan, Moore, Schumacher, & Talbott, 2005) is associated with heavier drinking compared to other locations. One study found that students’ BAC was higher after drinking alcohol at a party as opposed to drinking at the participant’s house, their friend’s house, a bar or restaurant, fraternity, or a relative’s house (Usdan et al., 2005). In contrast, Clapp, Reed, Holmes, Lange, and Voas (2006) found that participants drank significantly more if their last drinking occasion was at a public location (i.e., a bar or club) than if it was at a private party. Additionally, an analysis of three waves of the U.S. National Alcohol Surveys indicated that individuals who drink at bars are more likely to engage in fighting, arguments, and drunk driving than those who
drink the same amount at home (Nyaronga, Greenfield, & McDaniel, 2009). Another study found that drinking in bars or taverns was associated with higher levels of alcohol consumption and drinking-related problems as opposed to other venues (Single & Wortley, 1993). In a multilevel examination across up to five drinking occasions, Demers et al. (2002) found that location influenced alcohol intake such that discos or bars were associated with more drinking than home, but home was associated with more drinking than restaurants. Similarly, parties and off-campus locations were associated with more consumption. Overall, these findings may suggest that drinking in bars and at parties in particular may represent a high-risk, hazardous drinking environment for college students.

Research indicates that an individual’s social drinking context may influence personal drinking behaviors. One experimental study found that college students may model other’s behavior when drinking, such that individuals tend to consume more alcohol when a confederate modeled heavy consumption than when a confederate modeled light consumption (Collins, Parks, & Marlatt, 1985). Additionally, a recent daily diary study revealed that college students tend to consume more alcohol on days when they spent more time socializing (Finlay, Ram, Maggs, & Caldwell, 2012). Further, a longitudinal study indicated that greater frequency of drinking in social contexts was associated with higher likelihood of alcohol abuse, alcohol dependence, and drunk driving two to three years later (Beck, Caldeira, Vincent, & Arria, 2013). And the multilevel examination by Demers et al. (2002) also revealed higher alcohol intake with friends and acquaintances than with family. Altogether, these findings indicate that a college student’s drinking context (i.e., location and social environment) could impact their own drinking habits and, in turn, possibly put them at risk for experiencing negative alcohol consequences.
Although many researchers have identified that more frequent PBS use is associated with lower alcohol consumption and negative consequences (e.g., Martens et al., 2005), scant research has examined how one’s drinking context may promote or hinder PBS use. Because many PBS involve a social element (e.g., avoiding drinking games, having a friend let you know when you have had enough to drink), it may be particularly relevant to determine whether or not individuals experience diminished strategy use in a social drinking context. That is, individuals who favor a social environment or perceive social benefits from drinking may believe that using PBS inhibits their ability to enjoy their drinking experience. Consequently, drinking in a social location (e.g., a bar or party) may be associated with a reduced likelihood of implementing PBS while drinking. Furthermore, identifying particular contexts that are associated with reduced PBS use for individuals may have clinical implications. That is, when discussing PBS use with college students during an alcohol intervention, interventionists could focus on specific situations that may put an individual at higher risk for failing to use PBS.

When determining alcohol use outcomes potentially associated with a college student’s drinking context (e.g., PBS use, alcohol consumption), it may be particularly beneficial to use designs that allow for examination of both individual differences (between-person) and event-level analysis (within-person). Consequently, the present study employed a longitudinal diary design, whereby participants recorded their alcohol use behaviors close to the time they occurred (i.e., within the past week). Such designs reduce recall biases that may occur in studies that ask participants to report on their typical alcohol use behaviors in the past month or year (Gmel & Daeppen, 2007). Only a handful of extant studies examining PBS and alcohol outcomes (Lewis et al., 2012; Linden-Carmichael, Braitman, & Henson, 2014; Pearson, D’Lima, & Kelley, 2013) have used a short assessment window or daily diary design. Given the potential benefits yet
dearth of such methodologies, a recent review of PBS called for more longitudinal, event-level, and within-subjects methodologies to more effectively understand the way in which factors such as PBS associate with alcohol outcomes (Pearson, 2013).

**Current Study**

The present study aimed to examine how the context of drinking each day (i.e., where and with whom) influences level of daily consumption directly, as well as through the use of PBS. A similar investigation was conducted for alcohol-related problems at the weekly level, controlling for consumption level for the week. Two different dimensions of PBS are examined (i.e., “Limits” or limiting overall consumption, and “Avoidance” or avoiding alcohol in general / specific alcohol situations), as well as their direct relationship with daily drinking. Moreover, we explored these relationships intra-individually (within-person across time), as well as inter-individually (between people), as these relationships may be different.

**Method**

**Participants**

Participants \((n = 417)\) were invited to complete weekly retrospective surveys assessing the previous 7 days of behavior, and each participant was invited to complete assessments for five weeks (i.e., a total of 35 days). After eliminating participants who did not drink during the assessment period \((n = 133)\), the final sample size for the current study was \(n = 284\) participants with an average age of 20.50 \((SD = 4.10;\) range = 18-49). Most of the sample was female \((69.0\%;\) \(n = 196\)) and White \((63.4\%;\) \(n = 180\)) or African-American/Black \((20.8\%;\) \(n = 59\)). Across this final sample, complete data (i.e., all weeks completed) were present for \(n = 35\) \((12.3\%)\) of participants, with 2 or more weeks provided by \(n = 186\) \((65.3\%)\). Number of weeks completed did not vary by sex \((p = .271)\). Data were provided for 4893 days \((M = 17.23\) per
participant), but only drinking days were examined for the current study (days = 1348; $M = 4.75$ per participant).

**Procedure**

Students enrolled in psychology courses in a mid-size public university were recruited through an online study participation system. Participants completed the first assessment of their past week’s behavior in a research lab where research staff described the follow-up procedure. Every Monday for the following four weeks, participants received an email from research staff with an invitation and link to complete the online follow-up survey assessing their past week’s behaviors. They were encouraged to complete the survey on Monday or Tuesday to minimize retrospective bias. Participants received course credit for each survey completed, with follow-up credit being given only if the survey was completed on Monday or Tuesday. An identifier created for research purposes was entered into each survey to link responses across time while keeping responses anonymous. This study was conducted in compliance with APA ethical standards and was approved by the institution’s Internal Review Board.

**Materials**

Participants were asked if they consumed alcohol for each day of the previous week. For each day that the participants reported drinking, a series of follow-up questions were asked regarding how much they drank, who they were with, where they were, and the types of PBS used. Participants were also asked which alcohol-related problems they experienced (if any) in the past week.

**Alcohol use.** A single item asked how many standard drinks the participant consumed on that drinking day ($M = 4.92, SD = 4.17$). Examples of standard alcohol drinks (e.g., beer, wine, liquor) were provided to participants with pictures provided to illustrate the size of each drink.
PBS AND DRINKING CONTEXT

PBS. PBS reported each drinking day were assessed with a modified version of the Protective Behavioral Strategies measure (Novik & Boekeloo, 2011). This scale consists of 17 items across two dimensions. The “Limits” dimension (9 items; $M = 1.00, SD = 1.23$) captures behavior regarding limiting total alcohol consumption, including prior planning (e.g., “determine in advance not to exceed a set number of drinks”) as well as during consumption (e.g., “make your own drinks”). The “Avoidance” dimension (8 items; $M = 2.79, SD = 1.65$) captures behavior regarding either avoiding alcohol altogether (e.g., “avoid situations where there was alcohol” or “drink an alcohol look-alike”) or avoiding specific types of alcohol or activities that might lead to drinking excessively (e.g., “avoid drinking games”). These subscales have been demonstrated as having good reliability across sex and race (Novik & Boekeloo, 2011). Because it was assessed daily, the response scale was modified to indicate if each strategy was used that day ($1 = yes, 0 = no$).

Drinking context. Two types of drinking context were assessed for each drinking day: environmental (i.e., where they drank) and social (i.e., with whom they drank). Participants were presented with a list of potential contexts and asked to check all that apply for environmental (i.e., home, bar, restaurant, party) and social (i.e., alone, with friend[s], with family) contexts. This resulted in four variables for environmental context and three variables for social context that were each dichotomously coded ($1 = yes, 0 = no$).

Problems. Alcohol-related problems were assessed using the Rutgers Alcohol Problem Index (RAPI; White & Labouvie, 1989). Items were dichotomously scored to indicate if a participant endorsed experiencing each problem/item ($1 = yes, 0 = no$), with all items summed to create a total score. Problems were assessed weekly to indicate which problems (if any) the participants experienced for the entire week.
Analysis Approach

Given the nested nature of the data (i.e., days nested within people) and the aims regarding indirect effects, multilevel structural equation modeling (MSEM) was used (Preacher, Zyphur, & Zhang, 2010). MSEM allows for the simultaneous investigation of separate level-1 (intra-individual or within-person) and level-2 (inter-individual or between-person) effects while preventing the conflation of these effects. Because all variables for the models with number of drinks as the outcome were assessed at the daily level (i.e., level 1), this model could be considered a 1-1-1 model, per Preacher et al. (2010). As seen in Figure 1, the variables observed at the daily level were modeled as a combination of latent within-person and between-person values. The between-person values were analogous to the means for that individual (e.g., average PBS use across drinking days), but were modeled as latent variables, such that the daily observed variables served as indicators of average person-level use. The within-person variables were analogous to person-centered values for the day (e.g., PBS total for that day minus the individual’s average PBS use); however, they were also modeled as latent variables, serving as the variation from that individual’s latent average use.

As seen in Figure 1, the model examined how the predictor variable of drinking context, X, influenced the outcome variable of number of drinks, Y, both directly as well as indirectly through the mediator variable of PBS use, M. Separate models were examined for each type of drinking context (i.e., environmental and social contexts), as well as for each type of PBS (i.e., Limits and Avoidance), resulting in 4 final models conducted in Mplus (version 7.4; Muthén & Muthén, 2008-2015). An additional 4 final models were conducted with alcohol-related problems as the outcome of interest. Because problems were assessed for the prior week, number of standard drinks consumed that week was included a covariate. This provided
estimates of the unique influence of context and PBS on problems, controlling for consumption levels.

Due to the potential non-normality of the underlying distributions for the indirect effects, 95% Monte Carlo confidence intervals (MCCIs) were used to assess their significance (Preacher & Selig, 2012), where confidence intervals not containing the value of zero were considered significant. The MCCIs were generated with code created using Selig and Preacher’s (2008) web-based utility. For each indirect effect, parameter estimates were entered for the path from $X$ to $M$ (path $a$), the path from $M$ to $Y$ (path $b$), the variance of the $a$ and $b$ paths, as well as the covariance of the two paths, pulled from the asymptotic covariance matrix from the original models. The mean was used for any random within-person slopes. The MCCIs were generated using the statistical software R (R Core Team, 2015), with 100,000 replications. Model building procedures were used to examine the inclusion of direct effects, random within-person slopes, and sex as a covariate (coded as 0 = female, 1 = male). By comparing nested models in pairs, direct comparisons were made for model fit, as determined by statistically significant likelihood ratio tests. Because restricted maximum likelihood estimation was used, the log-likelihood values were compared for each null and alternative model pair, with a scaling correction factor used for each model (Muthén & Muthén, n.d.).

Results

An examination of the data resulted in five outliers being winsorized for number of drinks consumed and one for alcohol-related problems. No outliers were present for either dimension of PBS. In addition, number of drinks was log transformed due to the skewness of the original metric. No transformations were necessary for problems or either dimension of PBS. A series of unconditional multilevel models indicated that intraclass correlation coefficients were
.409 for number of drinks, .520 for PBS Limits, and .573 for PBS Avoidance at the daily level, and .515 for problems at the weekly level, indicating that their variances are comprised of relatively equal components of within-person and between-person variance, supporting the MSEM approach. Means and standard deviations are presented by sex in Table 1 for each PBS dimension (daily) and number of drinks (daily) as well as alcohol-related problems (weekly). Also seen in Table 1 are the means for each context.

**Model Building Summary**

The models tested in the model building process, their associated fit, and likelihood ratio test rests of model comparisons are included in Table 2. For each context and PBS dimension combination, the base model (i.e., Model 1) included only the hypothesized indirect effects of context on PBS and PBS on number of drinks consumed or problems experienced, both between- and within-person (i.e., no direct effect) with no random slopes within-person. Because of its associations with drinks consumed and PBS both in the literature (Pearson, 2013; Prince, Carey, & Maisto, 2013; Wilsnack, Wilsnack, Kristjanson, Vogeltanz-Holm, & Gmel, 2009) and in the current data, all models controlled for sex by including it as a predictor at level-2. Model 2 then added the between- and within-person direct effects. As seen in Table 2, the inclusion of direct effects significantly improved model fit for all context and PBS combinations for models with consumption as the outcome, but not for models with problems as the outcome. Model 3 then explored incorporating random slopes for the within-person effects: Model 3a incorporated random slopes for path “a” from context to PBS (both outcomes), Model 3b incorporated random slopes for path “b” from PBS to drinks consumed (both outcomes), and Model 3c incorporated random slopes for path “c” from context to drinks consumed (consumption models only, as direct effects were omitted from the problems models based on the prior step). As seen in Table
2, model comparisons among consumption outcomes favored fixing all within-person paths for the models examining the Limits dimension of PBS, whereas random slopes for “b” paths are incorporated for the final models examining the Avoidance dimension of PBS. Model comparisons among alcohol-related problems favored fixing all within-person paths. Finally, Model 4 explored removing sex as a covariate, but comparison procedures supported keeping it in all final models. Thus, all context and PBS combinations supported including indirect effects while controlling for sex. Indirect effects were included in consumption models only. Also in consumption models only, random slopes were incorporated only for the “b” paths, and only for the Avoidance dimension of PBS.

**Within-Person Environmental Context**

*Limits PBS.* As described in the “Within” column of Table 3, specific environments for each drinking day were significantly related to the Limits dimension of PBS. Drinking at a bar or party was associated with significantly less PBS use that day. In turn, higher use of Limits PBS that day was significantly associated with fewer drinks consumed after controlling for context. In addition, direct effects indicate that drinking at a bar or party that day was associated with significantly more drinks consumed after controlling for Limits PBS use. There were also two significant indirect effects from environmental context to drinking through the Limits dimension of PBS. Drinking in a bar or at a party was associated with consuming more drinks that day through the Limits dimension of PBS, such that those drinking environments were associated with lower PBS use, which was associated with higher consumption.

Similar findings were revealed for alcohol-related problems. As seen in the “Within” column of Table 4, drinking at a bar or party was associated with significantly less PBS use that day. In turn, higher use of daily Limits PBS was significantly associated with fewer weekly
problems experienced, after controlling for weekly consumption. Similarly, there were two significant indirect effects from environmental context to problems through the Limits dimension of PBS. Drinking in a bar or at a party was associated with experiencing more problems that week through the Limits dimension of PBS, such that those drinking environments were associated with lower PBS use, which was associated with more problems.

Avoidance PBS. In contrast to the Limits PBS findings, specific environments for each drinking day were not significantly related to the Avoidance dimension of PBS (see Table 3). However, direct effects still indicate that drinking at a bar or party that day was associated with significantly more drinks consumed after controlling for Avoidance PBS. Also contrary to Limits PBS findings, daily use of Avoidance PBS was not significantly associated with drinks consumed after controlling for environmental context. Indirect effects were not observed for the Avoidance dimension of PBS. Similar findings were revealed for alcohol-related problems (see Table 4). Specific environments for each drinking day were not significantly related to the Avoidance dimension of PBS, nor was Avoidance PBS significantly associated with problems after controlling for consumption. As such, there were no significant indirect effects.

Between-Person Environmental Context

Limits PBS. As seen in the “Between” column of Table 3, person-level tendencies (latent averages) to drink in specific environments were not significantly related to the Limits dimension of PBS. However, average Limits PBS use was significantly negatively associated with drinks consumed after controlling for environmental context, such that higher Limits PBS use was associated with fewer drinks consumed. In addition, direct effects indicate that tendencies to drink at bars and parties were associated with significantly more drinks consumed after controlling for average Limits PBS use, whereas tendencies to drink at restaurants were
associated with significantly fewer drinks consumed. Sex did not influence average Limits PBS use, but males consumed significantly more drinks after controlling for average PBS use. Unsurprisingly, there were no significant indirect effects from environmental context to drinking through Limits PBS use at the person level.

No significant findings were revealed for alcohol-related problems (see Table 4). Specific environments for each drinking day were not significantly related to the Limits dimension of PBS, nor was Limits PBS significantly associated with problems after controlling for consumption. As such, there were no significant indirect effects from environmental context to problems through Limits PBS use. Sex did not influence average Limits PBS use, nor did it influence number of problems reported, controlling for consumption levels.

Avoidance PBS. Results were consistent for the Avoidance dimension of PBS with one notable exception. As seen in Table 3, general tendencies to drink in specific environments were also not significantly related to the Avoidance dimension of PBS. Once again, direct effects indicate that tendencies to drink at bars and parties were associated with significantly more drinks consumed after controlling for Avoidance PBS use, whereas tendencies to drink at restaurants were associated with significantly fewer drinks consumed. Contrary to Limits PBS findings, average Avoidance PBS use was not significantly associated with drinks consumed after controlling for environmental context. Males reported significantly lower average Avoidance PBS use and consumed significantly more drinks after controlling for PBS use. There were no significant indirect effects from environmental context to drinking through Avoidance PBS use.

Again, few significant between-person findings were revealed for alcohol-related problems (see Table 4). Specific environments for each drinking day were not significantly
related to the Avoidance dimension of PBS, nor was Avoidance PBS significantly associated with problems after controlling for consumption. As such, there were no significant indirect effects from environmental context to problems through Avoidance PBS use. Males did report lower Avoidance PBS use, but no sex differences were observed for number of problems reported, controlling for consumption levels.

**Within-Person Social Context**

*Limits PBS.* As described in the “Within” column of Table 5, drinking with specific people on a particular drinking day was not significantly related to the Limits dimension of PBS; however, direct effects indicate that drinking with friends was associated with consuming significantly more drinks that day after controlling for Limits PBS. Using more Limits PBS on a particular day was associated with consuming significantly less after controlling for social context. There were no significant indirect effects from social context to drinking through Limits PBS use. For alcohol-related problems (see the “Within” column of Table 6), drinking with specific people on a particular drinking day was again not significantly related to the Limits dimension of PBS; however, Limits PBS was significantly, negatively associated with problems after controlling for consumption, such that more Limits PBS use was associated with fewer problems reported. There were no significant indirect effects.

*Avoidance PBS.* Similar to Limits PBS findings, drinking with specific people was not significantly related to Avoidance PBS use that day (see Table 5). Direct effects indicate that drinking with friends on a particular day was associated with significantly more drinks consumed that day after controlling for Avoidance PBS. In contrast to Limits PBS findings, however, daily use of Avoidance PBS was not significantly associated with drinks consumed. There were no significant indirect effects from social context to drinking through Avoidance PBS use. Similar
findings were revealed for alcohol-related problems (see the “Within” column of Table 6). Drinking with specific people on a particular drinking day was not significantly related to the Avoidance dimension of PBS, nor was Avoidance PBS significantly associated with problems after controlling for consumption. There were no significant indirect effects.

**Between-Person Social Context**

*Limits PBS.* As described in the “Between” column of Table 5, person-level tendencies to drink in specific social contexts were not significantly associated with the Limits dimension of PBS use. However, drinking with family more often was associated with consuming significantly fewer drinks after controlling for Limits PBS. Higher average Limits PBS use was associated with consuming significantly fewer drinks, after controlling for social context. Sex did not influence Limits PBS use, but males consumed significantly more drinks after controlling for PBS use. There were no significant indirect effects from social context to drinking through Limits PBS use.

Similar findings were revealed for alcohol-related problems (see the “Between” column of Table 6). Drinking with specific people on a particular drinking day was not significantly related to the Limits dimension of PBS, nor was Limits PBS significantly associated with problems after controlling for consumption. As such, there were no significant indirect effects from social context to problems through Limits PBS use. There were no significant sex differences among Limits PBS, nor for problems reported controlling for consumption levels.

*Avoidance PBS.* Similarly, person-level tendencies to drink in specific social contexts were not significantly associated with the Avoidance dimension of PBS use (see the “Between” column of Table 5). Drinking with family more often was still associated with consuming significantly fewer drinks after controlling for Avoidance PBS. Avoidance PBS use was not
significantly associated with consumption after controlling for social context. Males used significantly fewer Avoidance PBS on average, and consumed significantly more drinks after controlling for PBS use. There were no significant indirect effects from social context to drinking through Avoidance PBS use.

As seen in the “Between” column of Table 6, similar findings were once again revealed for alcohol-related problems. Drinking with specific people on a particular drinking day was not significantly related to the Avoidance dimension of PBS, nor was Avoidance PBS significantly associated with problems after controlling for consumption. As such, there were no significant indirect effects from social context to problems through Avoidance PBS use. Males again reported significantly lower average Avoidance PBS use, though there were no significant sex differences among problems, controlling for consumption levels.

**Discussion**

The current study used a weekly diary design to assess the intra- and inter-individual relationships between socio-environmental context and two types of PBS use (i.e., limiting one’s alcohol use, avoiding drinking). This association was further explored by testing whether different types of PBS use mediated the relationship between context and alcohol use. We found that individuals reduce their use of harm reduction strategies within particular socio-environmental contexts, and that the reduction of PBS use partially explains the association between context and alcohol use outcomes. In particular, greater tendencies of drinking in bars and at parties was associated with heavier alcohol use, both within and between individuals. This finding is consistent with much past research (e.g., Single & Wortley, 1993; Usdan et al., 2005) suggesting that bars and parties may promote heavier drinking. Building upon these findings, our study also found that drinking in these locations also covaries with PBS use. That
is, on days where participants drank at bars and at parties, they used fewer strategies designed to limit their consumption and risk level such as predetermining the number of drinks to consume, never leaving a drink unattended, and eating before or while drinking. One explanation for these findings may be associated with an individuals’ level of self-efficacy, or perceived ability for implementing PBS in certain contexts. For example, Bonar and colleagues (2011) compared college students’ self-efficacy for using PBS when imagining drinking in a bar, at a party, or in their own home. Researchers found that one’s confidence of using these strategies was lower in a bar or party context. As evidenced in our study, individuals did indeed use fewer limits-oriented PBS when drinking in these particular contexts. Moreover, Limits PBS use mediated the link between drinking location and alcohol use, such that drinking in a bar or at a party was related to fewer PBS used, which in turn was linked with drinking more heavily, and experiencing more problems after controlling for drinking. This is a particularly robust finding given its manifestation across multiple outcomes (i.e., both consumption, and alcohol-related problems after controlling for consumption). These findings demonstrate that PBS is a key variable to consider when studying associations between drinking locations and alcohol outcomes. Given that drinking in bars or parties can be associated with a host of negative consequences, such as aggressive behavior and drunk driving (Nyaronga et al., 2009) beyond heavy drinking, additional research investigating the role of PBS in environmental contexts and drinking outcomes is warranted.

It is important to note that the direct and indirect links between drinking location, use of PBS, and alcohol use bare two caveats. First, only strategies involving limiting one’s alcohol consumption or risk were related to amount of alcohol consumed and drinking context. One’s use of avoidance strategies, such as drinking alcohol look-alikes, alternating alcoholic and non-
alcoholic beverages, or avoiding drinking games, were unrelated to alcohol use or context across within- and between-subject findings. It may be that participants are using avoidance strategies more often when deciding not to drink rather than when they drink. Thus, because we examined only drinking days, we were limited in our ability to examine the extent to which avoidance strategies predict whether an individual drank rather than how much they drank. It may also be that one’s use of avoidance strategies may not be conducive to drinking within these contexts given one’s drinking intentions. That is, if an individual has decided to attend a party or go to a bar, they are likely going with the intention of drinking; thus, they are simply unlikely to use strategies that would stop them from drinking, even temporarily (e.g., carrying around a cup that does not contain alcohol) as compared to making attempts to limit the amount consumed (e.g., keeping track of how many drinks consumed). Additionally, the avoidance strategies involved multiple types of social drinking (e.g., avoiding drinking games, avoiding social situations with alcohol), and bars and parties are social settings. Participants may seek out these types of settings specifically to engage in social drinking. Future research examining PBS use when drinking may benefit more from studying specific strategies that involve limiting one’s drinking, and the context under which each strategy is most likely to be used.

A second caveat is that these direct (to PBS) and indirect (through PBS) associations with context only occurred when examining within-subject effects, or changes in one’s drinking behavior day to day. In other words, person-level tendencies to drink in these locations were not predictive of PBS use, but rather drinking within these contexts on particular days were associated with reductions in PBS use and heavier alcohol use. These findings highlight the importance of using within-subject research to detect certain fine-grained relationships. To date, only a handful of studies have examined PBS use within-person (e.g., Lewis et al., 2012; Linden-
Carmichael et al., 2015; Pearson et al., 2013). To provide the most relevant information for interventions capitalizing on knowledge about within-subject effects, additional daily or event-level research investigating PBS is needed.

Interestingly, although social context was associated with alcohol use, it was unrelated to both types of PBS. Specifically, drinking with friends as opposed to drinking alone or with family was associated with heavier alcohol consumption, but was not predictive of PBS use. Thus, it appears that one’s PBS use is independent of with whom one drinks. Additionally, PBS use was not an underlying mechanism in the link between social context and alcohol consumption. Some recent research has demonstrated a link between social norms and PBS (Arterberry, Smith, Martens, Cadigan, & Murphy, 2014), thus normative amounts of alcohol consumed within a group may be associated with various types of PBS use. Moving forward, knowing that PBS is a stable construct within type of social group, it may be useful to examine whether the drinking norm (i.e., amount of alcohol) within a group, rather than the type of group, covary with PBS.

It is also noteworthy that sex differences were observed for Avoidance PBS, such that males reported using fewer strategies that involve avoiding specific high-risk scenarios than women, but not Limits PBS. The observed sex differences are consistent with the overwhelming majority of PBS research, whereas the non-significant finding for Limits PBS use is in line with a handful of studies that found support for gender differences only among select domains of PBS (see Pearson, 2013 and Prince et al., 2013 for reviews). Walters and colleagues (2007) posit that gender differences in PBS use may emerge as a combination of female students being more aware of self-protection needs, as well as male students viewing protective behaviors as less socially desirable, or even a sign of weakness. This may speak to the need to address the utility
of PBS, particularly among male students. The current study findings may have important clinical implications. The within-subject findings that drinking within a bar or party context influence PBS use and, in turn, alcohol use, may be relevant for inclusion in extant college drinking interventions. The Brief Alcohol Screening and Intervention for College Students (BASICS; Dimeff et al., 1999) is one such harm-reduction intervention that often provides personalized feedback on one’s drinking behavior. One aspect of this intervention is to provide harm reduction strategies, such as the types of PBS assessed in the current study, that the drinker can use in future drinking situations. Inclusion of PBS as an intervention component has been linked with intervention efficacy (e.g., Barnett et al., 2007; Larimer et al., 2007), but it also may be beneficial to include personalized feedback about drinking within certain environmental contexts, or to target students who most often engage in drinking in these settings. With the knowledge garnered from this study that PBS may be particularly difficult or undesirable to use in certain locations, the interventionist may want to focus on these drinking locations as potential barriers to protecting oneself from harm. Additionally, given that self-efficacy to use PBS may be lower in bars and at parties (Bonar et al., 2011), a focus on developing more confidence or practice using these strategies may be particularly efficacious.

Several study limitations should be noted. First, although this study is advantageous in its use of a within-subjects design, the current study did not use a typical daily diary approach. That is, participants were asked to retrospectively reflect on their daily behavior at the end of each week, rather than prospectively reporting on each day’s behavior. Although retrospective methods such as the Timeline Follow-Back are widely used and have shown to produce valid assessments of drinking (Sobell & Sobell, 1992), and this weekly assessment window may allow for fewer recall biases than retrospective designs inquiring about behaviors in the last month, last
year, or “in general”, future work would benefit from the use of a prospective design such as daily diary or ecological momentary assessment. Such designs would be particularly beneficial given findings that direct comparisons of reporting for the same period revealed that retrospective reports may provide deflated estimations of drinking compared to real-time methods (Carney, Tennen, Affleck, Del Boca, & Kranzler, 1998; Patrick & Lee, 2010). Advances in technology allow researchers to easily execute prospective measurement, allowing more accurate assessment of the fine-grained characteristics of drinking patterns. Second, we used only one measure of PBS (i.e., Novik & Boekeloo, 2011) in the current study, but other published measures include additional types of PBS, such as manner of drinking (as measured by the Protective Behavioral Strategies Survey; Martens et al., 2005) or alternatives to drinking (as measured by the Strategy Questionnaire; Sugarman & Carey, 2007). Future work may wish to replicate our study with the inclusion of additional PBS measures. Similarly, two specific PBS items (i.e., “have a friend let you know when you’ve had enough” and “stop drinking at least 1-2 hours before going home”) can only occur in specific context (i.e., with a friend, and not at home). The use of multiple PBS measures in future research would imply more robust conclusions. Additionally, the current study focused on only physical situational factors (i.e., where participants drank and with whom). However, it has been demonstrated that motivation to drink can change across situations and contexts, strongly influencing alcohol intake (Kairouz, Gliksman, Demers, & Adlaf, 2002). Moreover, the number of people present during drinking episodes in addition to their social role may have an impact on an individual’s drinking behavior. Future research should incorporate the influence of social-cognitive context in addition to physical context, as well as assessing the number of people present during the drinking episode. Third, because the current study did not use an experimental design, we cannot infer causality.
That is, we cannot determine if location caused reductions in strategy use, or if reductions in certain strategies necessarily caused one to drink more alcohol. Finally, our population of interest consisted of college student drinkers; thus, our findings may not generalize beyond this population, such as in clinical populations or nonstudent emerging adults.

The current study represented the first to examine the role of PBS in the association between socio-environmental context and alcohol use. Using a weekly diary design, we found that environmental context (i.e., drinking at a bar or party) is associated with heavier alcohol use directly and indirectly through PBS that involve limiting one’s drinking, and that these effects occurred only at the daily (within-person) level. Additionally, social context (i.e., drinking with friends) predicts elevated drinking but is unrelated to PBS use. College student drinking interventions may benefit from a focus on increasing the use of PBS within potentially risky drinking environments to help reduce problematic alcohol use.
References


Kairouz, S., Gliksman, L., Demers, A., & Adlaf, E. M. (2002). For all these reasons, I do…


