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Clarifying Observed Relationships Between Protective Behavioral Strategies and Alcohol Outcomes: The Importance of Response Options

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Abstract

Protective behavioral strategies (PBS), or harm-reduction behaviors that can potentially reduce alcohol consumption or associated problems, have been assessed in varied ways throughout the literature. Existing scales vary in focus (i.e., broad vs. narrow), and importantly, in response options (i.e., absolute frequency vs. contingent frequency). Absolute frequency conflates PBS use with number of drinking occasions, resulting in inconsistencies in the relationship between PBS use and alcohol outcomes, whereas contingent frequency is less precise, which could reduce power. The current study proposes the use of absolute frequencies to maximize precision, with an adjustment for number of drinking days to extricate PBS use from drinking occasions, resulting in a contingent score. Study 1 examined the associations between PBS subscales using the Strategy Questionnaire (Sugarman & Carey, 2007) and alcohol outcomes, finding that in raw score form the association between PBS and typical alcohol outcomes varied greatly from significantly positive to significantly negative, but adjusted score relationships were all consistent with harm reduction perspectives. In addition, curvilinear relationships with typical alcohol use were eliminated using the score adjustment, resulting in linear associations. Study 2 confirmed the findings from Study 1 with a more precise timeframe, additional alcohol assessments, and heavier college drinkers. The relationships between alcohol outcomes and PBS in raw score form were again varied, but became consistently negative using the score adjustment. Researchers examining PBS and related constructs should consider modifying current scales to include a precise frequency response scale that is adjusted to account for number of drinking occasions.

Keywords

alcohol; alcohol-related problems; college students; protective behavioral strategies; response scale

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Heavy drinking among the college student population is pervasive and can lead to numerous individual and institutional negative consequences (Benton et al., 2004; Core Institute, 2006; Hingson, Zha, & Weitzman, 2009; O'Malley & Johnston, 2002; Perkins, 2002; Singleton, 2007). There are many consequences that are often associated with frequent alcohol use, which can range from mild (e.g., hangovers, missed classes; Core Institute, 2006) to severe (e.g., DUIs, traffic fatalities; Hingson et al., 2009). These can impact the academic institution via property damage, student attrition, and legal costs (Perkins, 2002).

A growing body of literature has examined protective behavioral strategies (PBS) and their ability to reduce college student drinking and associated consequences. PBS are harm-reduction behaviors that an individual can use to potentially reduce their consumption and/or associated problems. They are sometimes conceptualized as being used exclusively while drinking (e.g., Martens et al., 2004) or can also be used before or instead of drinking (e.g., Prince, Carey, & Maisto, 2013; Sugarman & Carey, 2007). The strategies include selective avoidance of riskier behaviors (e.g., taking shots of liquor, funneling, or shot-gunning beer), strategies to reduce the impact of alcohol on the body (e.g., eating before and during drinking, drinking slowly), and alternatives to alcohol use (e.g., finding other ways besides drinking to reduce stress). Consistent with the harm reduction approach, PBS focus on drinking reduction and drinking while mindful of possible consequences, rather than abstinence. Whereas some protective strategies target abstaining from alcohol (e.g., choosing to participate in enjoyable activities that do not include alcohol consumption), most strategies are techniques for reducing consumption (e.g., alternating alcoholic and nonalcoholic beverages, limiting cash before going out to drink), and thus focus on reducing harm (Sugarman & Carey, 2007).

PBS are a common component in successful multifaceted drinking interventions targeting college students, including in-person interventions such as BASICS (Dimeff, Baer, Kivlahan, & Marlatt, 1999; e.g., Mastroleo, Turrisi, Carney, Ray, & Larimer, 2010; Murphy, Dennhardt, Skidmore, Martens, & McDevitt-Murphy, 2010; Murphy et al., 2001; Simão et al., 2008; Turrisi et al., 2009) and other brief motivational interventions (e.g., Borsari & Carey, 2005; Carey, Carey, Henson, Maisto, & DeMartini, 2011; Carey, Carey, Maisto, & Henson, 2006; Carey, Henson, Carey, & Maisto, 2009; Marlatt et al., 1998). They are also a common component in computer-based interventions such as *e*-CHUG (e.g., Hustad, Barnett, Borsari, & Jackson, 2010; Murphy et al., 2010; Walters, Vader, & Harris, 2007), AlcoholEdu (e.g., Carey et al., 2011; Hustad et al., 2010; Lovecchio, Wyatt, & DeJong, 2010; Wall, 2006), Alcohol 101 Plus™ (e.g., Carey et al., 2011; Carey et al., 2009; Murphy et al., 2010), and other forms of remotely delivered personalized normative feedback (e.g., Bingham et al., 2010; Dimeff & McNeely, 2000; Kypri et al., 2009; Larimer et al., 2007; Martens, Kilmer, Beck, & Zamboanga, 2010; Neighbors, Lee, Lewis, Fossos, & Walter, 2009). PBS are readily targeted; interventions may include strategies students report using as part of their tailored feedback or may encourage students to use strategies to reduce risk of harm.

However, it appears that PBS feedback as a stand-alone intervention does not yield reductions in drinking (Martens, Smith, & Murphy, 2013). Thus, PBS may be a tool for change but not sufficient as the impetus for change itself. Multifaceted interventions lead to

higher success rates by targeting both motivation and the means for change. As such, PBS have been demonstrated as a mechanism of change, mediating the relationship between intervention and reductions in alcohol-related outcomes for college drinkers in multiple randomized, controlled trials (Barnett, Murphy, Colby, & Monti, 2007; Larimer et al., 2007; Murphy et al., 2012). However, three studies failed to detect mediation effects for PBS as the mechanism of change for interventions (Kulesza, Apperson, Larimer, & Copeland, 2010; Neighbors et al., 2009; Walters, Vader, Harris, Field, & Jouriles, 2009). In two of these instances, PBS was not targeted by the intervention (Kulesza et al., 2010; Walters et al., 2009). In the third study, inconsistent findings can be explained at least in part by assessment issues, as reviewed below.

Assessment of PBS

Of the multiple scales that assess the use of PBS (Pearson, 2013; Prince et al., 2013), the three most commonly used are the Protective Behavioral Strategies Survey (PBSS; Martens et al., 2005), the Strategy Questionnaire (SQ; Sugarman & Carey, 2007), and the Protective Behavioral Strategies Measure (PBSM; Novik & Boekeloo, 2011). Each scale conceptualizes different dimensions of PBS. The PBSS contains three subscales: *Limiting/ Stopping Drinking* is "directly or indirectly related to either stopping or slowing down one's alcohol consumption (e.g., 'hold onto a drink without drinking it')"; *Manner of Drinking* assesses "different ways that individuals can consume alcohol (e.g., 'avoid mixing different types of alcohol')"; and *Serious Harm Reduction* is "directly avoiding potentially very dangerous consequences (e.g., 'make sure you go home with a friend')" (Martens et al., 2005, p. 701). Each of the PBSS strategy dimensions are used while an individual is drinking.

The SQ contains three subscales: *Selective Avoidance* of heavy drinking activities and situations implies declining high-risk drinking opportunities, such as taking shots or participating in drinking games; *Strategies While Drinking* are used to slow consumption or reduce the effects, such as alternating alcoholic and nonalcohol beverages and eating before and while drinking; and *Alternatives to Drinking* are strategies focused on finding replacement behaviors besides drinking, including finding other ways to reduce stress and choosing to participate in other enjoyable activities (Sugarman & Carey, 2007). Similar to the PBSS, the dimensions of the SQ include behaviors while drinking and prior to drinking, but the SQ also assesses behaviors used to avoid drinking altogether.

Finally, the PBSM contains two subscales: *Limits* are "behaviors associated with limiting alcohol consumption prior to (via planning) or during consumption. For example, determining not to exceed a set number of drinks or keeping track of the number of drinks is a successful behavior to assure that alcohol limits are not exceeded"; *Avoidance* behaviors are "the manner in which students avoided drinking too much alcohol while socializing or partying or avoided alcohol altogether. For example, alternating nonalcoholic and alcoholic drinks and pacing the number of drinks per hour are behaviors to avoid drinking too much once the individual has already begun to consume alcohol" (Novik & Boekeloo, 2011, pp. 72–73). Both dimensions of the PBSM assess a mixture of behaviors that can be using during, prior to, or instead of drinking.

PBS Response Scales

In addition to the identification of different dimensions of strategy use, PBS measures vary in the type of response scales used. Both the PBSS and PBSM used 5-point or 6-point contingent response scales assessing how often respondents use the strategies (ranging from *never* to *always*). However, the PBSS assesses how often each item is used when the respondent is drinking or partying, and the PBSM assesses how often each item is used when the respondent is socializing. In contrast, The SQ uses a grouped frequency response scale for behaviors (i.e., *none, once, 2–3 times, 4–5 times, 6–10 times, more than 10 times*) with no specific context given.

Inconsistent PBS Relationships and Response Scales

The differences in PBS conceptualization and assessment may explain why the results of student PBS use have been inconsistent across extant research. In fact, many studies find that PBS use is related to lower alcohol consumption (Benton, Benton, & Downey, 2006; Benton et al., 2004; Martens, Ferrier, & Cimini, 2007; Martens et al., 2005; Martens et al., 2008; Martens, Martin, Littlefield, Murphy, & Cimini, 2011; Martens, Pederson, LaBrie, Ferrier, & Cimini, 2007; Nguyen, Walters, Wyatt, & DeJong, 2011; Ray, Turrisi, Abar, & Peters, 2009; Sugarman & Carey, 2007), but others have found that consumption is not related to PBS use (Martens et al., 2011; Sugarman & Carey, 2009). Also, curvilinear associations have been reported (Sugarman & Carey, 2007; Werch, 1990), such that higher PBS use from below average to average is associated with higher consumption, but higher PBS use from average to above average is associated with lower consumption (like an upside down U). This is likely due to the conflation of higher PBS use and more frequent drinking when PBS are assessed with absolute frequency rather than contingent frequency (discussed in more detail below). Most studies found that PBS are associated with fewer alcohol-related problems (Benton et al., 2006; Benton et al., 2004; Borden et al., 2011; Delva et al., 2004; Martens et al., 2005; Martens et al., 2008; Martens et al., 2011; Martens, Pederson, et al., 2007; Martens et al., 2004; Ray et al., 2009); however, some studies found only limited support of the effects of PBS on consequence, such that the relationship was not observed for male students after controlling for relevant covariates (Delva et al., 2004; Werch, 1990) or not observed cross-sectionally (Luebbe, Varvel, & Dude, 2009).

Further examination of the studies with results inconsistent with harm reduction theories reveal that assessment is often at the heart of these inconsistencies. In the case of the study by Luebbe and colleagues (2009), the six items used were created by the researchers to assess a very narrow scope: protecting women from harm caused by the malicious intent of others. Thus three items focus on knowing where their drink is, keeping their drink in their possession, and watching out for the physical safety of each other. Only the three remaining items focus on overall harm protection (e.g., setting a drink limit, planning on how to get home, and eating before drinking), potentially explaining why researchers did not detect an association between PBS and alcohol-related problems. Similarly, in a study failing to detect PBS as a mediator for an intervention focusing on drinking behaviors during the week of one's 21st birthday (Neighbors et al., 2009), the inability of the intervention to impact change in PBS was likely due to a modification to the response scale for the PBSS. Students

indicated if each strategy was used that week (i.e., yes/no), yielding equal scores for a participant who used one strategy once versus a student who used that strategy repeatedly, causing a lack of sensitivity in measurement. In the case of researchers who created their own PBS scale (Delva et al., 2004), the assessment of PBS was quite appropriate. Researchers used 10 items, many of which can be found in the more common PBS scales. They also used a contingent response scale indicating the frequency with which different strategies were used when partying/socializing (ranging from *never* to *always*). The lack of association between PBS and alcohol-related problems was likely due to assessment issues with the scale for problems. In this instance, seven items were assessed with a dichotomous response (i.e., yes/no) for the past year. Again, a participant who regretted an action once after drinking had the same score as a participant who regretted their actions after drinking numerous times throughout the year, causing a lack of sensitivity in measurement.

Finally, for the three remaining studies that found either that PBS were unrelated to alcohol outcomes (Sugarman & Carey, 2009), or that PBS have a curvilinear relationship with outcomes (Sugarman & Carey, 2007; Werch, 1990), all three studies used PBS measures with an absolute frequency response scale. Two of these studies used the SQ with the associated response scale (i.e., grouped number of times each strategy was used; Sugarman & Carey, 2007; Sugarman & Carey, 2009). Werch (1990) developed 14 PBS items, asking participants how often they used each strategy in the past 6 months from *never* to *always*, without context, indicating absolute frequency because their endorsement was not contingent on particular circumstances such as partying or drinking. This indicates the explanation for these inconsistent findings may lie in the response scale rather than the content the items used. To determine whether the differences in the estimated associations between PBS and alcohol use between the SQ (often used with absolutely frequency responses) and the PBSS (often used with contingent frequency responses) were due to the content of the items or the type of response scale, Kite and colleagues (2013) added the alternative response scale options to the traditional administration. They found that contingent response options yielded the expected negative associations between PBS and alcohol use and problems, regardless of whether the SQ or the PBSS was used. Further, they found that absolute response options yielded nonsignificant and sometimes positive associations between the PBS and alcohol use and problems, regardless of whether the SQ or PBSS was used. This would indicate that it is the choice of response scale rather than the scale content that is causing the inconsistent relationships between PBS and alcohol outcomes.

These measurement and association inconsistencies have already been summarized by Kite, Pearson, and Henson (2013); Pearson (2013); Pearson, Kite, and Henson (2012), and by Prince, Carey, and Maisto (2013). Specifically, absolute frequency response scales (e.g., number of times) combined with assessment of PBS dimensions that are used while drinking conflates PBS use with alcohol use, given that more drinking occasions lead to more opportunities to use PBS. This can lead to counterintuitive associations with alcohol use and problems (e.g., positive, curvilinear, or nonsignificant relationships). The inconsistent relationship between PBS and alcohol use has been observed repeatedly with the SQ (Kite et

al., 2013; Pearson et al., 2012; Sugarman & Carey, 2007, 2009) as well as other scales (Kite et al., 2013; Werch, 1990).

In contrast to absolute response scales, contingent response scales tend to confirm the hypothesized harm-reduction relationships, such that higher PBS scores are associated with less alcohol consumption or related problems, particularly when the PBSS is used (Kite et al., 2013; Martens, Ferrier, & Cimini, 2007; Martens et al., 2005; Martens et al., 2008; Martens et al., 2011; Martens, Pederson, et al., 2007; Pearson et al., 2012; Walters, Roudsari, Vader, & Harris, 2007). Contingent response scales (i.e., ranging from *never* to *always*) correct the problem of conflation by assessing how often students engage in PBS relative to how often they drink, but they lack precision in comparison to some absolute frequency scales. Individuals who used a particular strategy two, three, or four times may have all endorsed *sometimes* for the associated item in a contingent response scale and would have equal rank (which would indicate equality for the purpose of associations with other variables). In contrast, absolute frequencies offer more precise measurement, particularly if the response options are ungrouped and respondents can indicate an exact number of times each strategy was used (i.e., *zero*, *one*, *two*, *three*, *four*, etc.). This allows for more accurate ranking across participants and assessment of correlational relationships, which translates into more power for prediction. However, conflation of PBS assessment with number of drinking occasions is still an issue if exact absolute frequencies are used, which can lead to results inconsistent with hypothesized harm-reduction relationships.

The current study seeks to unravel this conflation issue while maintaining more precise measurement by adjusting the raw PBS scores based on an absolute frequency response scale by the number of drinking occasions. This should remove curvilinear, nonsignificant, and positive relationships with alcohol variables documented in the literature, resulting in associations more consistent with harm reduction (i.e., higher PBS use relating to lower levels of drinking and related problems). To make this adjustment, exact count frequencies must be used rather than grouped frequencies.

Specifically, the current research focuses on the SQ by Sugarman and Carey (2007). Although the PBSS is used more commonly (Pearson, 2013), it focuses only on strategies that can be used while individuals are drinking alcohol or in drinking situations. The current study focuses on a broader scope of PBS behaviors, including preparations prior to drinking and alternatives to drinking altogether. Preparations prior to drinking as well as redirecting to nondrinking behaviors are both strategies students naturally use, and assessing them represents a more complete picture of harm reduction behaviors (Howard et al., 2007; Miller & Munoz, 2005; Prince et al., 2013). In addition, although the more narrow definition of PBS including only strategies used while drinking is more popular in the literature (Pearson, 2013), this may be, in part, due to the difficulties researchers have encountered with inconsistent findings using the broader definition. In addition, the conflation issue we seek to unravel is only present in absolute response scale associated with the SQ; the PBSS and PBSM both use contingent response scales.

Hypotheses

The current pair of studies seeks to identify an appropriate response scale for measuring PBS use that is precise while avoiding conflation with number of drinking occasions. For both studies, an exact count response scale with absolute frequencies is used to increase precision and power (as compared to contingent or grouped frequency response scales). We expect that PBS in raw score form (i.e., absolute frequencies) will have associations with alcohol variables inconsistent with harm reduction predictions, yielding nonsignificant, positive, and curvilinear relationships. Further, we expect that once PBS scores have been adjusted for number of drinking occasions, they will yield the hypothesized significant, negative associations with alcohol variables, which is consistent with harm reduction predictions. For Study 1, we expected that adjusting raw PBS scores to control for number of drinking days would change the associations with typical alcohol outcomes, such that they are strengthened and are consistently negative. We also determined if curvilinear relationships were eliminated using the adjusted PBS scores. We confirmed and expanded these results in Study 2 using a more precise drinking assessment across numerous indicators of alcohol use.

Study 1

Purpose

Study 1 examined the associations between the SQ PBS subscales and alcohol measures, including a general assessment of typical alcohol use and heavy alcohol use commonly used in the literature. The PBS response scale was modified to reflect a true count outcome (i.e., absolute response scale), and the associations were examined using both raw scores and scores adjusted to account for number of drinking occasions. Eligibility criteria included having at least one alcoholic drink per typical week, yielding a sample containing many light drinkers (with 29.7% reporting consuming three drinks or fewer in a typical week). Finally, we explored the curvilinear associations of PBS with alcohol use previously reported in the literature (Sugarman & Carey, 2007; Werch, 1990) using both raw and adjusted PBS scores.

Method

Participants—The sample for Study 1 consisted of 347 college students who reported having at least one alcoholic drink per typical week. Participants were recruited from the undergraduate pool of students taking psychology courses. They received course credit for their participation. The sample was mostly female (n = 239; 68.9%), mostly Caucasian or White (n = 210; 60.5%) or African American or Black (n = 100; 28.8%), and fairly evenly distributed across class standing. The average age was 23.35 years old (SD = 6.62, min. = 18, max. = 57). Participants completed an online assessment that assessed PBS, alcohol use, alcohol-related problems, and demographic information. All surveys for Study 1 were completed online from remote locations to generalize to typical online assessments.

Measures: Protective behavioral strategies

Protective behavioral strategies: PBS use during a typical week for the past 30 days was assessed using a modified version of Sugarman and Carey's (2007) SQ. Participants

answered 21 items using a modified 12-point count rating scale indicating the frequency of strategy use for a typical week (i.e., *None, 1 time, 2 times, 3 times, …, 9 times, 10 times, more than 10 times*). This allowed for a more sensitive assessment than the original grouped frequency 6-point rating scale (i.e., *none, once, 2–3 times, 4–5 times, 6–10 times*, or *more than 10 times*). The scale consists of 3 dimensions: Selective Avoidance of Risky Drinking Practices (e.g., not participating in drinking games, not doing shots); Strategies While Drinking (e.g., eating before and while drinking, limiting cash); and Alternatives to Drinking (e.g., finding other ways besides drinking to reduce stress). Composite scores were created for each subscale by summing the responses of relevant items; the total score composite was created by summing all items. Internal consistency based on raw scores was good for all three subscales and for the entire scale (Selective Avoidance: $\alpha = .92$, Strategies While Drinking: $\alpha = .94$, Alternatives to Drinking: $\alpha = .87$, total PBS: $\alpha = .96$).

Adjusting PBS scale scores: For the dimension of Alternatives to Drinking, the raw frequency is an appropriate metric that reflects how often the participant avoided drinking and chose alternate activities. However, for the dimensions of Selective Avoidance and Strategies While Drinking, because these items are only possible in drinking contexts and the response scale reflects raw number of times the strategy was used, it conflates PBS use with frequency of drinking. An increase for this raw score could reflect higher PBS use proportionate to frequency of drinking, but could also reflect the same proportionate use of PBS with more drinking episodes. To tease out proportionate PBS use, the raw PBS scores for these two dimensions were divided by the number of drinking days within a typical week, resulting in an adjusted score that reflects amount of PBS use controlling for frequency of drinking, where higher scores reflect using PBS more often while drinking, even if not drinking more often. Specifically, the adjusted score represents the average number of PBS used during a drinking day. We assessed the reliability of these adjusted scores by calculating α based on each item divided by number of drinking days (mathematically equivalent to dividing the scale score by number of drinking days). These adjusted scores still yielded good internal consistency (Selective Avoidance: $\alpha = .95$, Strategies While Drinking: $\alpha = .95$, total PBS: $\alpha = .96$).

Alcohol use: Participants' alcohol use was assessed using a modified version of the Daily Drinking Questionnaire (Collins, Parks, & Marlatt, 1985). Participants completed a grid indicating how many alcoholic drinks they consumed each day during a typical week for the past 30 days, where a drink was defined as a 12-ounce bottle or can of beer, a 5-ounce glass of wine or wine cooler, a 1.5-ounce shot of hard liquor, such as rum, gin, vodka, or whiskey straight or in a mixed drink, or similar portion of alcohol (Dufour, 2001). In addition, participants completed a second grid indicating how many alcoholic drinks they consumed each day during their heaviest drinking week for the past 30 days. A total alcohol quantity count for each type of drinking week was created by summing drinks reported across the grid.

Alcohol-related problems: Alcohol-related problems were assessed using the Young Adult Alcohol Consequences Questionnaire (YAACQ; Read, Kahler, Strong, & Colder, 2006). The YAACQ consists of 48 items assessing negative consequences associated with alcohol

use, and respondents indicate with a dichotomous response whether they experienced each consequence within the past 30 days. The total score was used for the current study, and internal consistency was good ($\alpha = .93$).

Results

Analyses—Outliers (two for number of drinks in a typical week, six for number of drinks in a heavy drinking week) were Windsorized (Barnet & Lewis, 1994). Values identified by box-plots as more than three interquartiles ranges beyond the center interquartile range were considered extreme scores and were Windsorized, or reduced to values slightly larger than the most extreme value not identified as an outlier, still maintaining rank among scores. Means and standard deviations for alcohol-related measures are included in Table 1. Correlations between raw PBS scores and alcohol outcomes as well as the revised correlations with adjusted PBS scores are shown in Table 1. As expected, controlling for the number of drinking days changed the differential functioning of PBS dimensions. In raw score form, relationships between PBS and alcohol variables were highly variable (i.e., columns 5–7 in top part of Table 1), with some relationships being significantly negative, some being nonsignificant but still negative, and some being positive (but nonsignificant). However, for the adjusted PBS scores (i.e., columns 5–7 in middle part of Table 1), PBS relationships were consistent across dimensions for alcohol quantity (both typical and heavy). For Selective Avoidance, Strategies While Drinking, and total PBS, the inconsistent positive effects of PBS with alcohol use and problems became negative, and the relationships which were already negative were strengthened. Consistent with harm-reduction approaches, correlations with adjusted PBS scores are all negative across all three outcomes and are significant for alcohol use.

Correlation difference tests—Fisher's *z*-scores (Preacher, 2002) were used to assess the change in correlations between PBS and alcohol outcomes prior to and after the adjustment for number of drinking days. Table 1 (bottom panel) displays the associated *z*-scores with significance levels. For typical alcohol consumption, its association with PBS was significantly strengthened across all relevant PBS scores (i.e., Selective Avoidance, Strategies While Drinking, and Total). For heavy alcohol consumption, although all three correlations were greatly strengthened, the only significant change was for Strategies While Drinking. Finally, for alcohol-related problems, its relationship with PBS was significantly strengthened for Strategies While Drinking and Total, though Selective Avoidance showed a similar nonsignificant trend.

Curvilinear assessment—To explore the previously reported curvilinear relationship between raw PBS scores and alcohol use (e.g., Sugarman & Carey, 2007), a series of four regressions were conducted (one for each PBS subscale plus the total score). For each regression, alcohol use was predicted by a centered linear term for raw PBS and the associated quadratic term for raw PBS. As seen in Table 2, the quadratic term was a significant predictor of alcohol use for all 4 raw PBS subscales, indicating curvilinear relationships. The negative coefficients for these quadratic terms indicate a concave relationship, such that in the low to moderate range of PBS, higher PBS is initially

associated with increased consumption rates, but in the moderate to high range of PBS, higher PBS becomes associated with reduced consumption.

To explore if these associations were maintained with the three adjusted PBS scores, the same regressions were repeated, but using the adjusted PBS subscales to represent PBS use proportionate to number of drinking occasions. The regression for *Alternatives to Drinking* remains unchanged because its endorsement is not conflated with frequency of drinking, so its score was not adjusted. An examination of a scatterplot between *Alternatives to Drinking* and alcohol consumption reveals that *Alternatives to Drinking* has less of an impact on consumption at lower levels, and only changes from medium to high use of Alternatives to Drinking lead to visible reductions in drinking. However, as seen in bottom half of Table 2, the quadratic term was no longer a significant predictor any of the updated regressions, but the linear term was significant for all three (Selective Avoidance, Strategies While Drinking, and total PBS). Consistent with our bivariate correlations, the regressions indicate a negative relationship where higher proportionate PBS use is associated with lower drinking levels.

To illustrate why these curvilinear associations disappear after adjusting PBS scores to account for number of drinking occasions, Figure 1 displays average PBS and alcohol measures for low frequency drinkers (i.e., 1–2 drinking days per typical drinking week) and high frequency drinkers (i.e., 3–7 drinking days per typical drinking week). As seen in the figure, raw PBS scores are comparable across both types of drinkers, even though high frequency drinkers drink significantly more and experience significantly more problems. However, in contrast to raw PBS scores, adjusted PBS scores are significantly lower for high frequency drinkers. This indicates that high frequency drinkers might report frequent PBS use (i.e., raw PBS score), but those instances of strategy use are spread across numerous drinking occasions and their adjusted PBS use is comparatively low. So in raw PBS score form, their high PBS use was associated with more drinking and problems. This means that both high PBS use (i.e., indicating more drinking days) and low PBS use (i.e., indicating unsafe drinking) were related to increased alcohol outcomes (contributing to a curvilinear relationship). However, in adjusted PBS score form, low PBS use (per drinking occasion) is, as expected, associated with higher drinking and problems (contributing to a negative linear relationship).

Comparison to controlling for frequency—The score adjustment used is an improvement on current commonly used methods such as statistically controlling for frequency. Statistically controlling for frequency removes shared variance with a focus on the outcome variable. Any variance in our outcome of consumption quantity that is due to number of drinking days (which is a substantial portion of the variance) is removed when assessing how much PBS influences the remaining unique quantity variance. Whereas, the score adjustment focuses on the influence of drinking days on PBS itself. This allows the new contingent PBS score to predict all variance in drinking, assessing its full influence. A regression examining the influence of the raw PBS total score on typical drinking indicates no significant influence, $b = -0.010$, $\beta = -0.079$, $p = .144$. A regression examining the influence of the raw PBS total score on typical drinking, controlling for number of drinking days, still indicates no significant influence, $b = -0.009$, $\beta = -0.071$, $p = .119$. This second regression represents the influence of the same conflated PBS variable on the unique

variance of quantity with the influence of drinking days removed. The coefficients have barely changed, despite the fact that number of drinking days is strongly related to quantity, $b = 2.415$, $\beta = 0.526$, $p < .001$. The variable of PBS use itself is still conflated with drinking days, causing the weak relationship. However, a regression with the adjusted PBS total score indicates a significant influence on typical drinking, $b = -0.042$, $\beta = -0.267$, $p < .001$. The same pattern of results is observed when exploring the influence of the raw PBS total score on heavy drinking, $b = -0.022$, $\beta = -0.101$, $p = .061$, its influence after controlling for number of drinking days, $b = -0.017$, $\beta = -0.080$, $p = .053$, and the influence of the adjusted PBS total score on heavy drinking, $b = -0.068$, $\beta = -0.242$, $p < .001$. Using the adjusted score yields stronger relationships with outcomes.

Discussion

Study 1 demonstrates that adjusting raw frequency PBS scores to account for number of drinking occasions creates consistent and expected negative associations with typical drinking measures for college students. This was confirmed across typical and heaviest drinking as well as with drinking consequences. In addition, the curvilinear relationships demonstrated in past research (e.g., Sugarman & Carey, 2007; Werch, 1990) disappear after controlling for number of drinking occasions. The score adjustment was demonstrated to be an improvement compared to the approach of statistically controlling for frequency.

Study 2

Purpose

The purpose of Study 2 was to cross-validate the findings from Study 1 with a more precise timeframe and with additional alcohol assessments. Daily drinking was assessed for a specific time window (2 weeks) to increase precision and additional indicators of heavy alcohol use were included. In Study 2, eligibility criteria included consuming four or more alcoholic drinks in the past two weeks and being between the ages of 18–24, yielding a sample of heavier drinkers with higher risk of experiencing associated problems.

Method

Participants—Participants were undergraduate college students who received course credit for their participation. Eligibility criteria consisted of being between the ages of 18 to 24 and consuming four or more alcoholic drinks in the past 2 weeks. As with Study 1, participants were recruited from the undergraduate pool of students taking psychology courses. The sample for Study 2 ($n = 392$) was mostly female ($n = 255$; 65.1%), mostly Caucasian or White ($n = 235$; 59.9%) or African American or Black ($n = 87$; 22.2%), and fairly evenly distributed across class standing with the exception of a small proportion of seniors ($n = 36$; 9.2%) with a mean age of 19.59 years old ($SD = 1.46$). Participants completed a computerized assessment that assessed PBS, alcohol use, alcohol-related problems, and demographic information. This computerized assessment was conducted in a research lab to minimize disruptions and distractions.

Measures—Similar measures of alcohol use, problems, and PBS were used but were changed to reflect recent use for the past 2 weeks (Study 2) rather than typical use for the past 30 days (Study 1).

PBS—PBS use during the past 2 weeks was assessed using the modified version of Sugarman and Carey's (2007) PBS scale described in Study 1. Participants answered 21 items using a 12-point interval rating scale indicating the frequency of strategy use in the previous 2 weeks (i.e., *None, 1 time, 2 times, 3 times, …, 9 times, 10 times, more than 10 times*). As before, composite scores were created for each subscale by summing the responses of relevant items; the total score composite was created by summing all items. Internal consistency based on raw scores was adequate for all three subscales (Selective Avoidance: $\alpha = .83$, Strategies While Drinking: $\alpha = .90$, Alternatives to Drinking: $\alpha = .80$, total PBS: $\alpha = .93$).

Adjusting PBS scale scores—As before, the dimension of Alternatives to Drinking was left in the appropriate raw frequency metric. However, Selective Avoidance and Strategies While Drinking were divided by the number of actual drinking days reported on the 2-week alcohol use grid (described below) to reflect proportionate PBS use, and total PBS was the sum of all three. These adjusted scores still yielded good internal consistency (Selective Avoidance: $\alpha = .87$, Strategies While Drinking: $\alpha = .92$, total PBS: $\alpha = .88$).

Alcohol use—Participants' alcohol use was assessed using a modified version of the Daily Drinking Questionnaire (Collins et al., 1985). Participants completed a grid indicating how many drinks they consumed on each day over the past 2 weeks, using the same definition for a drink as in Study 1 (Dufour, 2001). They also indicated how many hours passed during each drinking occasion. A total alcohol quantity score was created by summing drinks reported across the grid. Additionally, participants described their drinking in the past 2 weeks, including how many days they drank to the point of being intoxicated and on how many days they engaged in heavy drinking (i.e., five or more drinks for men and four or more drinks for women; Wechsler, Dowdall, Davenport, & Rimm, 1995). For their heaviest drinking day, participants were also asked how many hours passed during the drinking occasion to determine their blood alcohol concentration (BAC). BAC was estimated using a formula which takes into account number of drinks, hours over which the drinks were consumed, weight, and gender (Matthews & Miller, 1979).

Alcohol-related problems—Alcohol-related problems were assessed using the Brief Young Adult Alcohol Consequences Questionnaire (Kahler, Strong, & Read, 2005), which consists of 24 items assessing a single dimension of negative consequences, and respondents indicate with a dichotomous response whether they experienced each consequence within with past two weeks. The consequences listed range from mild (e.g., did embarrassing things or had a hangover) to more severe (e.g., had problems with interpersonal relationships or neglected obligations). A modified timeframe (2 weeks) was used for the current study to be consistent with the assessment of other alcohol constructs. Internal consistency was good ($\alpha = .82$).

Results

Statistical analysis plan—Outliers were again identified via boxplot and were Windsorized (Barnet & Lewis, 1994), bivariate normality was examined, and absence of multicollinearity was confirmed. Identified outliers included two values for number of days intoxicated, three values for number of heavy drinking days, one value for number of drinks on highest drinking day, one value for BAC on that highest drinking day, eight values for drinking quantity, and two values for the PBS subscale of Selective Avoidance. Means and standard deviations for alcohol-related measures are included in Table 3. To assess the associations between PBS and alcohol measures, simple bivariate correlations were used for both the raw and adjusted PBS scores. As before, Fisher's *z*-scores were used to assess if the changes in correlation were signification.

Consistency of associations—Consistent with previous research (e.g., Sugarman & Carey, 2007, 2009), correlations indicated that the PBS relationships with alcohol use and related problems (i.e., top part of Table 3 columns 5–10) differ across dimensions of PBS in the raw metric (e.g., different valence of effects and differing in levels of significance). However, Table 3 also displays the updated associations when Strategies While Drinking and Selective Avoidance are changed to reflect PBS use proportionate to drinking frequency (i.e., middle part of Table 3 columns 5–10). As in Study 1, controlling for the number of drinking days changed the differential relationship of PBS dimensions with drinking measures such that significant negative correlations were consistent across dimensions for alcohol quantity, alcohol-related problems, and number of days intoxicated.

These correlations are markedly different from the initial correlations in this heavier drinking sample. This change in pattern of associations may be most pronounced for number of heavy drinking days. Using the raw PBS scoring, it had a significant positive relationship with Strategies While Drinking, $r(390) = .12$, $p = .018$, a negative but nonsignificant relationship with Alternatives to Drinking, $r(390) = -.10$, $p = .058$, and almost no relationship with Selective Avoidance, $r(390) = -.05$, $p = .296$. This resulted in a nonrelationship with total PBS, $r(390) = .02$, $p = .655$. However, after adjusting raw PBS scores for frequency of drinking, all three of these relationships became significantly negative, with $r(390) = -.23$, $p < .001$ for Selective Avoidance, $r(390) = -.18$, $p = .001$ for Strategies While Drinking, and $r(390) = -.18$, $p = .001$ for overall total PBS.

Correlation difference tests—Fisher's *z*-scores were again used to assess the change in correlations between PBS and drinking variables prior to and after the adjustment for number of drinking days (Preacher, 2002). The bottom panel of Table 3 displays the associated *z*-score indicating if the difference between the raw and the adjusted PBS correlations was significant. As seen in the tables, the association between PBS and alcohol use was significantly changed across all relevant PBS scores (i.e., Selective Avoidance, Strategies While Drinking, and total PBS) for quantity of alcohol consumed, days intoxicated, and number of heavy drinking days. The relationship was significantly changed only for Strategies While Drinking for maximum number of drinks and associated BAC. Though the correlations with alcohol-related problems all became stronger, these changes were not significant.

Discussion

Study 2 replicated the findings of Study 1 with a more precise drinking assessment window, and extended to more risky drinking measures among a heavier drinking sample. As before, adjusting raw frequency PBS scores created consistent negative associations with alcohol variables, particularly days intoxicated, heavy drinking days, and peak BAC.

General Discussion

The problem of conflated PBS use with frequency of drinking has already been identified in the literature (Kite et al., 2013; Pearson, 2013; Pearson et al., 2012; Prince et al., 2013). However, by controlling for the number of drinking occasions in postsurvey calculations rather than in the stem of the item, the current adjustment allows for a more precise measure of PBS use (e.g., specific number of times) rather than broad categories (e.g., *never, sometimes, always*). The adjustment, in fact, turns an absolute frequency response scale into a contingent score with more precision than alternative contingent response scales. “When you are drinking” in the alternative response scales corresponds with exactly how many days they are drinking in the proposed adjustment. *Rarely* corresponds with 1 or 2 times, *occasionally* corresponds with 2 or 3 times, and so forth.

In raw score form, each dimension of PBS functioned differently in its association with alcohol use, with strategies designed to be beneficial (e.g., alternating alcoholic and nonalcohol drinks) unexpectedly relating to higher levels of use or problems. In raw score form, an individual who drank three days and used PBS all three times is equivalent to an individual who drank 14 days, but used PBS only three times. Adjusting PBS scores by drinking occasions to reflect proportionate PBS use yielded the expected pattern of higher levels of proportionate PBS use across all dimensions being associated with lower levels of alcohol use, consistent with harm reduction perspectives. In addition, the curvilinear pattern of associations sometimes observed between PBS and alcohol use (Sugarman & Carey, 2007; Werch, 1990) appears to be explained by frequent drinkers who have many opportunities to use PBS, but use only a few strategies. Once their high raw PBS scores are adjusted for number of drinking occasions, these curvilinear relationships become linear and negative, as expected. Finally, the score adjustment approach was demonstrated to be an improvement over the approach of statistically controlling for frequency. As the field continues to expand the body of literature on PBS, researchers should consider modifying current scales to include a precise frequency response scale that is adjusted to account for number of drinking occasions, yielding a precise contingent measure.

Compared to existing contingent response scales that make use of broader language such as “when you are partying” or “when you are drinking,” the proposed adjustment uses the same referent across items and across individuals by dividing by number of drinking days (i.e., within a single drinking day). With broader language, participants may interpret “when you are socializing” to mean within a single day, a single occasion, a single drink, and so forth. Using an adjustment such as the one proposed should increase consistency by ensuring participant scores are all using the same context. Drinking days were chosen for the current studies. However, drinking occasions or number of drinks may be of interest depending on the research question being addressed, and the types of PBS items most of interest. Future

research should explore if changes to the adjustment are more relevant to different research questions (such as dividing by number of drinks consumed for some items like “drinking slowly”).

Limitations

Limitations to the current study should be considered when interpreting these findings. The recommended response scale of count frequencies (ungrouped) limits assessment windows to what respondents can responsibly count, usually 1 to 2 weeks. These can be typical weeks that are representative of a longer time period as in Study 1, or actual calendar weeks as in Study 2. Although the current studies produced replicated findings, they both used samples drawn from a single institution and were both cross-sectional in nature. Results should be replicated with larger samples across multiple institutions and longitudinally. We also recommend that if other PBS scales are modified to use absolute frequency, then this adjustment should be considered as well. However, we focused our data collection only on the SQ due to its inherent absolute frequency response scale.

In addition, we compared our modified response option to the ungrouped response option (i.e., *0, 1, 2*, etc.) which is a more precise version of the commonly used response option for the SQ (i.e., *none, once, 2–3 times*, etc.). These yield identical results mathematically excepting that the grouped response scale should yield slightly weaker values due to the lack of precision. Our findings should also be compared to the more general contingent response scales of *never* to *always* used in the PBSS and PBSM. We anticipate that the proposed more precise assessment should yield similar but stronger relationships; however, this should be confirmed empirically.

Future Directions

Future research should further establish the in-depth psychometric properties of the SQ using this alternative response approach (e.g., confirmatory factor analysis, variations of adjustment by other drinking factors, longitudinal associations). The current findings should be extended to compare proportionate PBS use (calculated using the current count response scale adjusted after assessment) to contingent response scales (i.e., *never* through *always*). In addition, the current findings suggest recommendations for future research involving PBS. Researchers should consider altering the original response scaling for their PBS measure of choice to count responses so that the adjustment for drinking occasions can be made. Existing PBS measures (e.g., PBSS, Martens et al., 2005; PBSM, Novik & Boekeloo, 2011; SQ, Sugarman & Carey, 2007) contain items that easily lend themselves to this adjustment. In addition, researchers considering future scale development should keep these response options in mind for PBS, but also other constructs related to alcohol use that could contain the same conflation issue.

Conclusion

The current study highlights practical methodological issues related to the assessment of PBS using currently available scales. Studies examining PBS as a form of harm reduction have encountered methodological issues where count response scales for PBS use is

conflated with frequency of drinking (Kite et al., 2013; Pearson, 2013; Pearson et al., 2012; Prince et al., 2013). The current study used an absolute count response option, adjusted for the number of drinking occasions for relevant dimensions of PBS. This adjustment changed the differential associations of PBS use with alcohol outcomes, such that higher proportionate use of all PBS dimensions was associated with lower rates of consumption and related problems. Curvilinear associations were removed with this adjustment. The authors recommend using the revised response scale with the associated adjustment for future PBS research.

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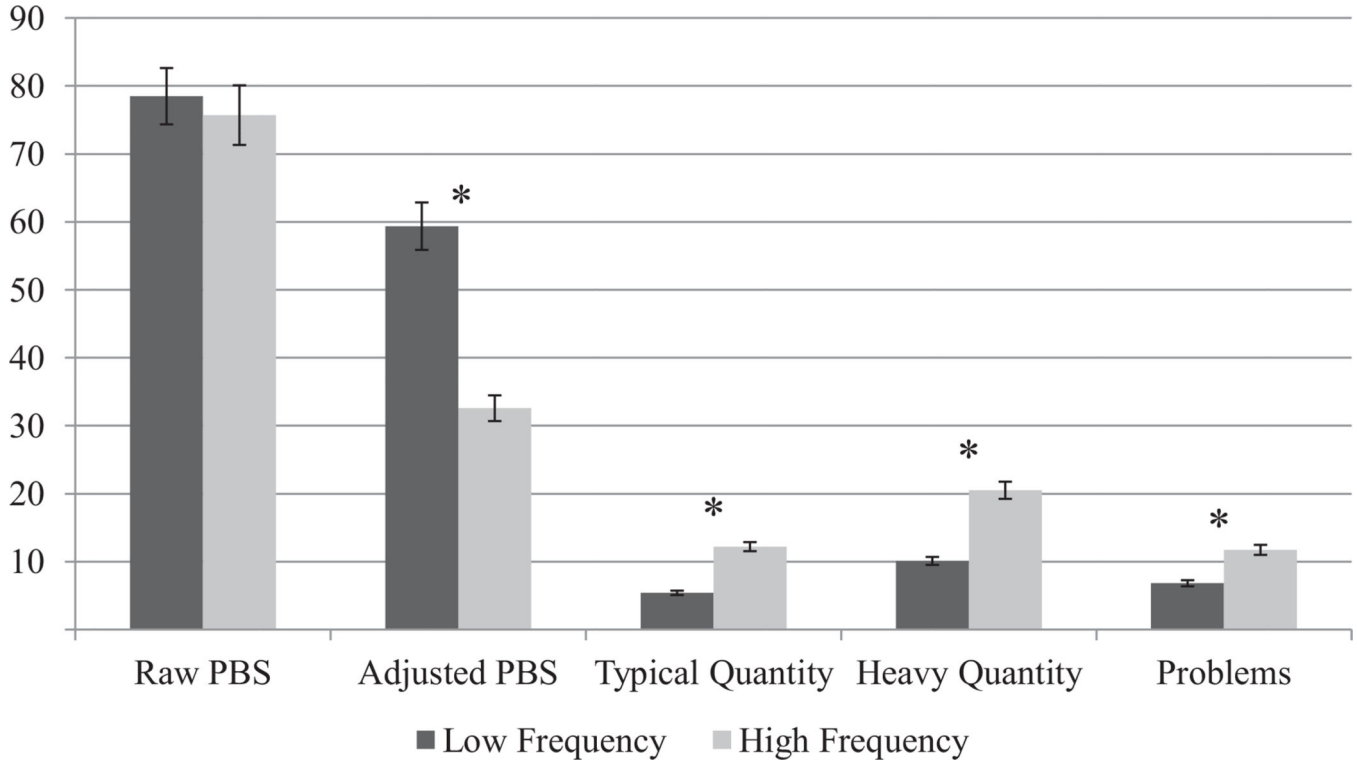

Figure 1.

Raw protective behavioral strategies (PBS), adjusted PBS, and alcohol outcomes by frequency of drinking. Note that "low frequency" refers to 1–2 drinking days per typical drinking week, and "high frequency" refers to 3–7 drinking days per typical drinking week. PBS refers to the total PBS score including all three subscales. Asterisks indicate significant mean differences at $p < .001$. The *y*-axis represents a different unit of measurement for each pair of bars in the chart. It reflects PBS score for raw PBS and adjusted PBS, the number of drinks for "typical quantity" and "heavy quantity," and the number of alcohol-related problems for "problems."

Psychol Addict Behav. Author manuscript; available in PMC 2015 July 22.

Table 1

Study 1: Correlations Among PBS Scores and Alcohol Use Outcomes

	1	2	3	4	5	6	7	*M*	*SD*
1. Raw PBS: avoid	—	.76***	.66***	.91***	−.15**	−.16**	−.01	21.22	21.08
2. Raw PBS: SWD		—	.65***	.94***	.03	.00	.10	37.80	28.66
3. Raw PBS: alternatives			—	.81***	−.16**	−.17**	.00	18.40	13.36
4. Raw PBS: total				—	−.08	−.10	.05	77.42	56.84
5. Typical week alcohol quantity					—	.82***	.47***	8.02	6.88
6. Heavy week alcohol quantity						—	.51***	14.12	12.34
7. Alcohol-related problems							—	8.71	7.75
1. Adj. PBS: avoid	—	.85***	.56***	.92***	−.29***	−.26***	−.15**	11.49	15.81
2. Adj. PBS: SWD		—	.58***	.94***	−.25***	−.21***	−.11*	19.13	20.39
3. Raw PBS: alternatives			—	.77***	−.16**	−.17**	.00	18.40	13.36
4. Adj. PBS: total				—	−.27***	−.24***	−.10	49.02	44.12
Z scores assessing correlation change									
1. Adj. PBS: avoid					1.99*	1.32	1.85		
2. Adj. PBS: SWD					3.66***	2.80**	2.82**		
3. Raw PBS: alternatives					—	—	—		
4. Adj. PBS: total					2.55*	1.91	2.03*		

Note. PBS = protective behavioral strategies; avoid = selective avoidance; SWD = strategies while drinking; alternatives = alternatives to drinking; Adj. = adjusted. Note that adjusted selective avoidance and strategies while drinking represent proportionate PBS use rather than raw frequencies. Alternatives to drinking remains in the raw metric, and adjusted total reflects the sum of these three subscales.

* $p < .05$.

** $p < .01$.

*** $p < .001$.

Psychol Addict Behav. Author manuscript; available in PMC 2015 July 22.

Table 2

Linear and Curvilinear Association of PBS and Adjusted PBS With Alcohol Consumption

Predictor	*b*	*SE*	*t*	*p*	β
Selective avoidance					
Linear	0.017	0.026	0.67	.503	0.052
Quadratic	−0.003*	0.001	−3.46	.001	−0.271
Strategies while drinking					
Linear	0.051*	0.016	3.24	.001	0.210
Quadratic	−0.002*	0.000	−4.73	<.001	−0.307
Alternatives to drinking					
Linear	−0.052	0.030	−1.72	.082	−0.101
Quadratic	−0.005*	0.002	−2.53	.012	−0.146
Total PBS					
Linear	0.011	0.008	1.33	.185	0.088
Quadratic	−0.000*	0.000	−4.14	<.001	−0.274
Adjusted selective avoidance					
Linear	−0.161*	0.044	−3.66	<.001	−0.370
Quadratic	0.001	0.001	0.90	.367	0.091
Adjusted strategies while drinking					
Linear	−0.066*	0.029	−2.29	.023	−0.197
Quadratic	0.000	0.001	−0.71	.477	−0.061
Adjusted total PBS					
Linear	−0.032*	0.012	−2.53	.012	−0.203
Quadratic	0.000	0.000	−1.05	.293	−0.084

Note. Outcome was typical week alcohol quantity for all regressions. Each linear/quadratic pairing was conducted in a separate regression. Linear predictors were centered, and these centered values were used to create the quadratic terms.

*$p < .05$.

Table 3

Study 2: Correlations Among PBS Scores and Alcohol Use Outcomes

	1	2	3	4	5	6	7	8	9	10	*M*	*SD*
1. Raw PBS: avoid	—	.73***	.54***	.87***	−.15***	−.11*	−.15*	−.05	−.16**	−.09	15.33	14.61
2. Raw PBS: SWD		—	.55***	.94***	.05	−.02	.02	.12*	.03	.06	35.59	24.61
3. Raw PBS: alternatives			—	.74***	−.11*	−.12*	−.17**	−.10	−.02	−.05	18.90	11.72
4. Raw PBS: total				—	−.05	−.08	−.08	.02	−.04	−.01	69.86	44.65
5. Alcohol quantity					—	.44***	.73***	.72***	.76***	.60***	22.50	18.99
6. Alcohol-related problems						—	.50***	.38***	.34***	.35***	5.42	4.10
7. Number of days intoxicated							—	.76***	.59***	.53***	2.19	1.84
8. Number of heavy drinking days								—	.59***	.49***	2.71	2.21
9. Number of drinks on heaviest drinking day									—	.78***	7.38	4.30
10. Heaviest drinking day BAC										—	0.58	0.11
1. Adj. PBS: avoid	—	.78***	.47***	.80***	−.34***	−.14**	−.30***	−.23***	−.26***	−.18***	4.44	4.96
2. Adj. PBS: SWD		—	.50***	.85***	−.29***	−.13*	−.24***	−.18***	−.16**	−.10	9.55	7.69
3. Raw PBS: alternatives			—	.87***	−.11*	−.12*	−.17**	−.10	−.02	−.05	18.90	11.72
4. Adj. PBS: total				—	−.25***	−.15**	−.26***	−.17***	−.13**	−.11*	32.89	20.65
Z scores assessing correlation change												
1. PBS: avoid					2.79**	0.51	2.12*	2.48*	1.36	1.25		
2. PBS: SWD					4.81***	1.54	3.68***	4.15***	2.78**	2.18*		
3. PBS: alternatives					—	—	—	—	—	—		
4. PBS: total					2.82**	1.02	2.48*	2.77**	1.29	1.34		

Note. PBS = protective behavioral strategies; avoid = selective avoidance; SWD = strategies while drinking; alternatives = alternatives to drinking; BAC = blood alcohol concentration, Adj. = adjusted. Note that adjusted selective avoidance and strategies while drinking represent proportionate PBS use rather than raw frequencies. Alternatives to drinking remains in the raw metric, and adjusted total reflects the sum of these three subscales.

* $p < .05$.

** $p < .01$.

*** $p < .001$.