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Covariations of Emotional States and Alcohol Consumption: Evidence from Two Years of Daily Data Collection

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Abstract

We examined inter- and intra-individual covariations of mood and alcohol consumption in a sample of 171 light, medium, and heavy alcohol consumers aged 21 and over who reported daily about drinking and mood for a period of up to 2 years. The sample was recruited by advertisements in local newspapers and referral from former respondents in Northern Vermont, USA, between July 1997 and September 2000. Participants reported daily alcohol consumption and mood via Interactive Voice Response (IVR) technology. Within-subject correlations were calculated for each individual separately and analyzed via cluster analysis. The cluster solution was subsequently used as a categorical level-2 predictor in hierarchical linear modeling of daily alcohol consumption. Cluster analyses of the within-subject correlations revealed four clusters: (1) emotion-inhibited drinking (drinking combined with reduced emotional arousal, $n = 12$); (2) "positive emotion drinking" (drinking in combination with positive mood, $n = 69$), (3) "stress drinking" (drinking combined with negative mood, $n = 12$), and (4) "non-emotional drinking" (no relationship between alcohol consumption and mood, $n = 78$). Hierachical linear modeling (HLM) analyses revealed that a significant amount of random variance of the Level-1 mood slopes (38% and 40%) was accounted for by the clusters, demonstrating the predictive power of cluster membership on individual drinking patterns. Although Cluster 3 members (stress drinking) did not report significantly higher levels of alcohol consumption, they were more likely to report current and lifetime dependence symptoms. The results point to the existence of stable, but diverse drinking patterns among non-clinical alcohol consumers with potentially different implications for development into alcohol abuse and dependence.

Keywords

Alcohol consumption; mood; stress; gender; cluster; USA

Research on the relationships between mood and alcohol consumption has a long tradition. Inspired by a variety of tension-reduction, motivation, and alcohol expectancy models (e.g., Cappell & Herman, 1972; Levenson, Sher, Grossman, Newman, & Newlin, 1980; Sayette, 1993; Young, Oei, & Knight, 1990), alcohol consumption patterns were studied primarily as a response to negative life events (Frone, Cooper, & Russell, 1994; Stewart, 1996), stress

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(Armeli, Carney, O'Neil, Tennen, & Affleck, 2000; M. L. Cooper, Russell, & Frone, 1990; Young & Oei, 2000), and a variety of related negative affective states including anxiety (Kushner, Sher, Wood, & Wood, 1994), depressive symptoms (Stephens & Curtin, 1995), and negative mood (Steptoe & Wardle, 1999; Swendsen, Tennen, Carney, Affleck, Willard, & Hromi, 2000). However, evidence for stress-related drinking models was mixed, fostering both the development of refined models and the search for moderators (M. L. Cooper, Russell, Skinner, Frone, & Mudar, 1992; Rutledge & Sher, 2001; Sayette, 1999; Young et al., 1990).[1]

In recent years, the focus has shifted towards an inclusion of multiple drinking motives and positive affective states as previously under-researched antecedents of alcohol consumption (Carney, Armeli, Tennen, Affleck, & O'Neil, 2000; M. L. Cooper, Frone, Russell, & Mudar, 1995). Cooper (A. M. Cooper, 1994; M. L. Cooper et al., 1995) identified at least two distinct mood-related drinking motives: (1) coping with negative emotions, and (2) enhancement of positive affect. According to these authors, stress-reduction theories and self-medication hypotheses ignore emotion-enhancement motives of alcohol consumption, and thus, an important link between positive emotional states and drinking. Both the existence of multiple drinking motives and the link between positive mood and drinking are well supported in the literature (M. L. Cooper et al., 1995; Mohr, Armeli, Tennen, Carney, Affleck, & Hromi, 2000; Simons, Gaher, & Correia, 2005; Wilkie & Stewart, 2005). However, little is known about the distribution of emotion-related consumption patterns in a population of non-clinical regular alcohol consumers. Because stress-related drinking is assumed to increase the risk of abuse and dependence, and consequently, the risks of alcohol-related health problems, arrests for driving while intoxicated, and accidents, it is imperative to determine the proportion of stress drinkers in this population and compare their risks to those of differently motivated alcohol consumers.

Research on the links between stress and drinking calls for a thorough investigation of the intra-personal covariations over many repeated observations (Affleck, Zautra, Tennen, & Armeli, 1999; Tennen, Affleck, Armeli, & Carney, 2000). In contrast, the vast majority of studies has focused on differences in mood and alcohol consumption across individuals only. Researchers increasingly recognize the unsuitability of between-subject analyses for genuinely within-subject hypotheses and employ daily diary methods instead (Affleck et al., 1999; Stephen Armeli, Tennen, Todd, Carney, Mohr, Affleck et al., 2003; Swendsen et al., 2000). Within-person and between-person correlations of mood and alcohol consumptions have been found to differ in both magnitude and direction (Affleck et al., 1999; Tennen et al., 2000). Both conceptually and empirically, between-person designs do not provide answers for the question whether a person drinks more or less when in a specific mood state.

Ultimately, between- and within-subject analyses have to be combined in order to extract patterns in the relationships between mood and drinking that provide the most useful insights. Gender, in particular, must be considered as a potential moderating factor of within-person drinking patterns given the well-known gender differences in alcohol use (Holmila & Raitasalo, 2005). Gender differences in the amount of drinking are commonly explained with biological differences as well as gender-specific drinking norms, which are more restrictive for women. Both lower drinking levels as well as the potentially reduced variance in drinking behavior among women point to potentially reduced covariations of mood and drinking among women. This assumption is supported by several findings in the literature indicating that men are more likely to engage in stress-induced drinking and, thus, more prone to use alcohol as a means of

[1]In the following, we will use the term "stress" interchangeably with "negative emotions." Our decision is based on our commitment to transactional stress theory (Lazarus & Folkman, 1984), which emphasizes the cognitive-emotional mediators of stress, as well as on the claim that the level of stress is best measured in terms of its emotional concomitants (Lazarus, 1990).

regulating negative affect (M. L. Cooper et al., 1992; Dawson, Grant, & Ruan, 2005; Frone et al., 1994).

Daily, near-contemporaneous self-reports offer the opportunity to assess both between-and within-subject correlations of mood and alcohol consumption and, in addition, promise more valid and accurate results than retrospective summary reports of alcohol consumption (Helzer, Badger, Rose, Mongeon, & Searles, 2002; Perrine, Mundt, Searles, & Lester, 1995; Perrine & Schroder, 2005). However, to date, only a limited number of studies have used daily self-reports of mood or stress and alcohol consumption. In addition, most studies do not exceed a self-reporting period of 30 to 60 days (see, for example, Armeli et al., 2003; Bardone, Krahn, Goodman, & Searles, 2000; Hussong, Galloway, & Feagans, 2005; Swendsen et al., 2000; Todd, Armeli, Tennen, Carney, Ball, Kranzler et al., 2005). Because alcohol consumption does not necessarily occur every day, is often limited by job demands, and thus, a matter of opportunity, longer self-reporting time intervals would be desirable in order to identify clear individual patterns of drinking and enhance the reliability of the observed within-subject correlations.

Against this background, the goals of the present study included (1) investigating daily, within-subject covariations between both positive and negative mood states and alcohol consumption over a two-year period, and (2) identifying inter-individual differences (clusters) in these within-person correlations. Based on the distinction between coping and enhancement motives (M. L. Cooper et al., 1995), we hypothesized that both positive and negative mood states might correlate separately with increased alcohol consumption. Cluster analyses were performed with the aim of identifying groups of individuals who show: (a) increased alcohol consumption distinctly in combination with emotional distress; (b) increased drinking in association with positive mood only; (c) increased drinking in combination with both negative and positive mood states; and (d) no association or reduced drinking in any emotionally aroused state. The following hypotheses were tested:

1. In the majority of regular non-clinical alcohol consumers, changes in alcohol consumption co-vary with changes in emotional states. However, individuals differ in their pattern of associations between mood and alcohol consumption and can be clustered accordingly. Following the motivational model of alcohol use (M. L. Cooper et al., 1995), at least two potential clusters can be derived. First, drinking to cope with negative emotions suggests a cluster characterized by a positive correlation between stress and alcohol consumption. Second, drinking to enhance positive emotions points to a cluster of drinkers showing increased alcohol consumption in combination with positive mood states. Further, both drinking motives could co-exist in the same individuals, pointing to a possible third cluster of individuals with increased alcohol consumption in both positive and negative mood states. Finally, a fourth cluster might be expected grouping people whose drinking patterns are less driven by emotional states but depend more on habit and similar factors that are not related to mood.
2. Gender affects the amount of drinking and moderates the covariations of mood and alcohol consumption at both between- and within-person levels. This assumption is based on the common observation of lower levels and reduced variance in alcohol consumption among women as well as findings in the literature pointing to gender as a moderating factor in the relationship between stress or negative mood and drinking (M. L. Cooper et al., 1992; Dawson et al., 2005; Frone et al., 1994; Holmila & Raitasalo, 2005).
3. Individuals who show increased drinking in combination with stress are more likely to be heavy drinkers and more likely to show a history of abuse and/or dependence.

Method

Emotional states and alcohol consumption were collected daily in a sample of 173 alcohol users (as defined by a minimum of 1 drink per week) who agreed to report daily about their mood and behavior over a period of two years.

Recruitment

A sample of 186 alcohol consumers was recruited by advertisements in local newspapers in Northern Vermont, USA (and, in some cases, by referral from former subjects), and enrolled between July 1997 and September 2000. The present study focused on 178 light, medium, and heavy drinkers who reported daily on alcohol consumption and emotional states and fulfilled the following eligibility criteria: (a) age 21 or older; (b) alcohol user; (c) no manifestation of mental disorder; (d) not in treatment for alcohol-related problems; and (e) at least 100 days of regular daily self-report. Five participants failed to provide the desired number of self-reports before dropping out and were excluded. Thus, the sample size for the present study was N = 173.

In a part of this sample, we found strong and long-term effects of the September 11, 2001, terrorist attacks on the World Trade Center and the Pentagon on the mood ratings (see Perrine, Schroder, Forester, McGonagle-Moulton, & Huessy, 2004). To avoid contamination, only self-reports provided up to September 11, 2001, were included in the analyses.[2] This cutoff date applied to 94 of the 173 participants (54% of the sample) who entered the study after September 11, 1999 and who supplied between 35 and 383 daily self-reports (M = 223, SD = 126.9) beyond the cut-off date of September 11, 2001. In total, 94,793 observations were included in the analyses, with a minimum of 121 and a maximum of 738 repeated self-reports per participant (M = 670.1, SD = 166.1).

Procedure

Respondents to the initial advertisement were invited to a 2-hour face-to-face screening session evaluating alcohol use, abuse, alcohol-related symptoms, and mental health. Preceding any assessment, respondents were informed about the purpose and procedures of the study and assured of the confidentiality of their responses. Alcohol users of all levels (1 to 2 standard drinks per session = light drinkers, 3 to 4 = medium drinkers; and 5 or more = heavy drinkers) were accepted if there was no indication of mental disorder according to DSM-IV criteria as assessed with the Computerized Diagnostic Interview Schedule (C-DIS; Robins & Helzer, 1994). Respondents accepted for participation attended a one-hour face-to-face training session (in groups of eight to ten) introducing the Interactive Voice Response (IVR) method. The IVR combines computerized self-interviewing with touch-tone telephone technology and has been successfully applied to the daily reporting of alcohol consumption in the past (Mundt, Bohn, King, & Hartley, 2002; Mundt, Perrine, Searles, & Walter, 1995; Perrine et al., 1995; Searles, Perrine, Mundt, & Helzer, 1995). Participants called a dedicated toll-free number active throughout the United States and Canada, which was connected to a computer-automated system. Using personalized identification numbers, participants provided self-reports for up to 738 consecutive days. They responded to a short series of pre-recorded questions (e.g., “How many beers did you drink yesterday?”) by pushing numbers on the telephone keypad that corresponded to their answers.

[2]On and following September 11, negative mood ratings raised up to a level of about eight standard errors above the grand mean of the mood ratings as established by a 1-year baseline in this sample, an effect that was not observed in self-reports of alcohol consumption (Perrine et al., 2004). Because September 11, 2001, caused such a severe disruption in the time series of emotional states, data on and beyond this date was excluded from the present analyses.

In order to prevent potential under-reporting bias, participants were required to respond to approximately the same number of questions every day, regardless of whether they had consumed alcohol the previous day. If they did not consume alcohol on the previous day, they were asked an alternative series of questions concerning their reasons for not drinking. The complete IVR script is presented in Perrine et al. (2004). The average duration of each call was about 2 minutes. Subjects were prompted by the automated system if any daily calls were missed in the 7-day period. Subjects who missed two or more days in a row were contacted by a staff member and, if non-responsive, were terminated from the study. A sophisticated compensation schedule was used in order to retain participant motivation and to prevent missing data and premature drop-out. Participants accrued one bonus point for each daily call made on time (defined as a call made between the hours of 12:05 a.m. and 11:55 p.m. for a self-report referring to the previous day). Additional bonus points were assigned weekly for regular and on-time calling. Half of the bonus points were converted into dollars at quarterly intervals throughout the study; the remaining points were converted and paid out in full at the very end of the data collection period. In addition, an on-time call-in rate of >95% at the end of the 2-year period was rewarded with another $500 (Perrine et al., 2004).

Participant Characteristics

The sample consisted of 92 male and 81 female alcohol consumers (see Table 1). The mean age was 42 years (*SD* = 11.9, range 21–74), and the mean years of education was 14.0 (*SD* = 2.1), with a range from 7 to 17 years. Almost all participants were white. Most participants (*n* = 77, 45%) were married, 46 (27%) were single, and 50 (28%) were separated, widowed, or divorced; the majority (112, 65%) had at least one child. Further, 134 subjects (78%) were living with at least 1 other person in the household, and 39 (22%) were living alone. Abuse and symptoms of dependence, as assessed by DSM-IV criteria, were moderate, with a mean of 0.8 (*SD* = 0.9) for current abuse, 1.6 (*SD*= 1.2) for lifetime abuse, 2.4 (*SD* = 2.0) for current dependence symptoms, and 3.6 (*SD* = 2.1) for lifetime dependence symptoms. No differences were found between the genders, except for a higher number of lifetime abuse symptoms among men ($M = 1.9$, $SD = 1.2$ vs. $M = 1.4$, $SD = 1.2$, $t = 2.73$, $p < .01$).

Measures

Alcohol consumption—When participants called in, they responded to a series of questions, including: (1) “How many beers did you drink …?”, “How many drinks containing liquor did you have …?”, and “How many glasses of wine did you have …?” The questions indicated the day of the week (e.g., Tuesday), which was the day preceding the call if calls were made on time. Participants were advised to count the number of drinks according to pre-defined standard sizes. One beer was defined as 12 ounces or a regular-size bottle or can. One serving of liquor was defined as 1.5 ounces of 80 proof distilled spirits, or the size of a regular shot. Thus, for a “double,” two drinks were to be reported. A regular glass of wine was defined as a 4-ounce serving; accordingly, a bottle of wine was to be counted as 7 glasses of wine. The units were chosen to reflect 45 ml of ethanol per drink. Based on these measures, a simple, unweighed sum score was computed, counting the numbers of standardized drinks per day, which provides a proportional estimate of the milliliters of alcohol consumed daily. Validity of these measures had been established prior to this study in combination with the IVR technology (see Perrine et al., 1995).

Emotional states—Following questions on alcohol consumption, participants were asked to provide ratings of five emotional states experienced on the previous day. Three items were chosen to represent a broad, common dimension of stress and negative affect. Participants were asked to indicate their level of stress on the index day using an 11-point response scale ranging from *no stress* (0) to *very highest stress* (10). Similarly, anger was rated from *not at all angry* (0) to *the angriest I’ve ever been* (10), and sadness was rated from *not at all sad* (0) to

saddest I've ever been (10). Coefficient alpha, computed over all observations, was .85 for the three items representing negative mood. Further, two items were chosen to represent positive emotions and uplifts experienced on the previous day. Happiness was rated from *not at all happy* (0) to *the happiest I've ever been* (10), and an overall rating of the previous day was requested on a scale from *the worst day ever* (0) to *the best day I've ever had* (10). Coefficient alpha for the two items representing positive mood was .86 in the present sample. Based on the mood ratings used in this study, we found pointed effects of the September 11, 2001, terrorist attacks on the World Trade Center and the Pentagon in the entire sample, indicating strong emotional reactions to this event and providing evidence for validity of these measures (Perrine et al., 2004).

Alcohol Dependence and Abuse Symptoms—Alcohol abuse and dependence were evaluated using the Composite International Diagnostic Interview – Substance Abuse Module (CIDI-SAM; Cottler, Robins, & Helzer, 1989). This interview was conducted individually and face-to-face by a trained staff member. The CIDI-SAM assesses dependence symptoms on an 8-point scale, ranging from 0 to 7, and abuse symptoms on a 5-point scale, ranging from 0 to 4. Any current dependence symptoms were reported by 130 (75.1%) participants who reported an average of 3.18 symptoms (*SD* = 1.67), and any lifetime dependence symptoms were reported by 158 (91.3%) participants who reported an average of 3.89 symptoms (*SD* = 1.88). Current abuse symptoms were reported by 63 of 113 participants (55.8%) who responded to this question with an average of *M* = 1.48 (*SD* = .72) and lifetime abuse symptoms were reported by 139 out of 172 participants (80.8%) with an average of *M* = 2.02 (*SD* = 1.05).

Data Analytic Strategy

Data analyses were performed with SPSS 11.0.1., and HLM 5.04 (Raudenbush et al., 2001; Raudenbush & Bryk, 2002). In order to test Hypotheses 1 and 2, both between- and within-subject correlations of mood and alcohol consumption were analyzed. Alcohol consumption required a log10 (x+1) transformation to approximate the data to a normal distribution. For *between-subject analyses*, repeated measures were aggregated over individuals, resulting in a single mean score for each variable per person. For *within-person analyses*, correlations between the five emotional states and alcohol consumption were computed separately for each individual over the 735 repeated measures. These correlations were entered into a new data file, which was used to retrieve average correlations with alcohol consumption, separately for each of the five mood states, using Fisher's z-transformation. In both data files, outliers ($z >= |3sd|$) were reduced to $\pm 3sd$ to reduce their impact on the results. Gender differences in both between-subject and within-subject correlations were analyzed via t-tests.

Hypothesis 1 (individuals differ in their pattern of correlations between mood and alcohol consumption) involved K-means cluster analyses of the within-subject correlations. A four cluster solution was requested with the expectation that one cluster would group individuals showing greater drinking in combination with negative mood (stress drinking), a second cluster of individuals showing greater alcohol consumption in combination with positive mood (positive emotion drinking), a third cluster grouping individuals who report more drinking in combination with any emotional arousal (whether negative or positive), and a fourth cluster identifying emotion-independent drinkers. Reliability of the cluster solution was evaluated in a subsequent discriminant analysis testing the efficiency of classification of cases into clusters (Stevens, 2002; Tabachnik & Fidell, 1996), using the within-subject mood-alcohol correlations as predictors. This method informs about the reliability of each cluster in terms of the percentage of cases correctly classified.

Hypothesis 2 claimed gender differences in the relationships between mood and drinking. With regard to the cluster solution, gender differences were tested via a chi-square test.

In order to determine the amount of within-person variation in daily drinking accounted for by the clusters (i.e., their effect sizes), hierarchical linear modeling techniques were employed, using the full data set, which yielded a total of 94,260 observations. A two-level hierarchical model was specified with a maximum of 735 observations per individual on Level 1, nested within individuals (n=171, Level 2). Two subjects had to be excluded from these analyses because of missing data in the set of predictor variables. The outcome was the daily number of standard drinks consumed. Because of the skewness of this variable, a Poisson model with over-dispersion was specified. Because alcohol consumption could be expected to increase on weekends, all analyses controlled for day of week, with Monday to Thursday coded as weekday (0) and Friday, Saturday, and Sunday coded as weekend (1).

A two-step approach was taken. The starting model (Step 1) controlled for the dummy-coded weekend variable on Level 1, and controlled for gender and current abuse symptoms on Level 2. Daily mood ratings were added as Level 1 predictors of alcohol consumption. In order to reduce the number of predictor variables, sum scores were computed separately for positive and negative emotions. The daily ratings of anger, stress, and sadness were standardized, and an average *negative mood* state per day was calculated from the *z*-scores. Similarly, an overall *positive mood* score per day was computed as the average of the *z*-transformed happiness and rateday scores. Because our focus was on the individual slopes rather than the average prediction of alcohol consumption, positive and negative mood were entered as group-centered predictors (i.e., centered for each individual separately). The Level 1 model took the form:

$$Log(no\ drinks_{ij})=\beta_{0j}+\beta_{1j}(neg.mood)+\beta_{2j}(pos.mood)+\beta_{3j}(weekend)+e_{ij}, \quad (1)$$

with subscript “i”coding the series of daily observations and subscript “j” coding the participant. To control for the effects of gender and current dependence symptoms on alcohol consumption, the Level 2 intercept was specified as:

$$\beta_{0j}=\gamma_{00}+\gamma_{01}(gender)+\gamma_{02}(dependence)+u_{0j}. \quad (2)$$

In the first step, no further predictors were added on Level 2. This strategy allowed for a calculation of variance components for the Level 2 residuals μ_{1j} and μ_{2j}, which inform about the amount of between-person (random) variation in the slopes of positive and negative mood states on alcohol consumption.

In the second step, the dummy-coded cluster membership was entered on Level 2, modeling the Level-1 slopes of positive and negative mood on alcohol consumption. These analyses were performed with the aim of determining the amount of unexplained random variance in the slopes of positive and negative mood states that could be accounted for by the clusters.

Thus, the equations for β_{1j} and β_{2j} read:

$$\beta_{1j}(neg.mood)=\gamma_{10}+\gamma_{11}(dummy_1)+\gamma_{12}(dummy_2)+\gamma_{13}(dummy_3)+\mu_{1j} \quad (3)$$

$$\beta_{2j}(pos.mood)=\gamma_{20}+\gamma_{21}(dummy_1)+\gamma_{22}(dummy_2)+\gamma_{23}(dummy_3)+\mu_{2j} \quad (4)$$

The variance components of μ_{1j} and μ_{2j} reduce to the degree that cluster membership predicts and modifies the individual Level 1 slopes of positive and negative moods. The variance explained by cluster membership can be determined as:

$$\Delta R^2_{\beta 1} = (Step_2\, \sigma^2_{\mu 1} - Step_3\, \sigma^2_{\mu 1}) / Step_2\, \sigma^2_{\mu 1}; \quad (5)$$

and

$$\Delta R^2_{\beta 2} = (Step_2\, \sigma^2_{\mu 2} - Step_3\, \sigma^2_{\mu 2}) / Step_2\, \sigma^2_{\mu 2} \quad (6)$$

Hypothesis 3 was tested by multivariate and univariate ANCOVAs using cluster membership as predictor and alcohol consumption, lifetime, and current abuse and dependence symptoms as dependent variables. These analyses controlled for the effects of age and gender.

Results

Descriptive Analyses and Gender Differences

Table 2 presents individual means and standard deviations (collapsed over the 735 repeated observations) for the emotion predictor variables and alcohol consumption. The average number of drinks per day was 3.5 (SD = 3.0), with a range from 0.2 to 16.2 drinks per day among the 173 participants. Women reported a lower number of drinks per day than men (M = 3.2 vs. M = 2.4, t = 4.98, $p < .0001$, for the natural log of number of drinks). On average, negative moods were rated lower than positive moods (2.3 vs. 6.1), but did not differ in variability. Marked gender differences appeared in negative mood ratings (anger: t = 2.87, $p < .005$; sadness: t = 3.53, $p < .001$; stress: t = 3.41, $p < .001$) and the composite measure of negative mood (t = 3.51, $p < .001$), with women scoring higher on negative emotions (see Table 2). The effect sizes usually exceeded 0.5 standard deviations. No gender differences were found in positive moods (happiness, day rating) or the composite positive emotions.

Bivariate Within- and Between-subject Relationships between Mood and Alcohol Consumption

Bivariate analyses of between- and within-subject correlations were performed separately by gender, using the normalized (log) number of drinks per day as outcome. The results are shown in Tables 3 and 4. For the *between-subject analyses*, the 735 repeated observations were aggregated, resulting in a single average score for each variable per subject, which then were correlated. Among men, most correlations were negative, and were significant for stress and overall negative emotions ($r = -.21$, $p < .05$). Among women, correlations between negative mood and alcohol consumption were positive, ranging from .24 to .27 (all ps < .05). Gender differences in the correlations with alcohol consumption were significant for stress (t = 2.93, $p < .01$), anger (t = 2.79, $p < .01$), sadness (t = 2.93, $p < .01$), and average negative emotions (t = 3.12, $p < .01$).

A different pattern emerged for *within-subject correlations*, using the matrix of individual correlations of mood and alcohol consumption that were computed separately for each subject (see Table 4). The within-subject correlations of the diverse mood states and drinking varied considerably, ranging from −.50 to +.50 among men and between −.35 and +.42 among women. On average, correlations did not differ significantly from zero. Also, there were no significant gender differences in the average within-subject correlations for any of the mood states.

Cluster Analyses of Within-Subject Correlations

According to Hypothesis 1, individuals differ in their pattern of associations between mood and alcohol consumption and can be clustered accordingly. Using the matrix of *within-subject*

correlations, K-Means cluster analyses were performed requesting four different clusters (see Table 5). The first cluster yielded 12 subjects (7%) showing a general tendency to drink less on days on which they reported any elevated mood ("emotion-inhibited drinking"). Cluster 2 comprised 69 subjects (40%) whose alcohol consumption appeared unrelated to negative moods but was enhanced on days with high positive mood ratings ("positive emotion drinking"). Cluster 3 grouped 12 subjects (7%) who drank more alcohol on days with elevated negative mood ratings and decreased drinking on days characterized by positive mood ("stress drinking"). Cluster 4 comprised the largest group of individuals (n=78, 46%) whose mood states appeared unrelated to their daily alcohol consumption ("emotion-independent drinking").

In order to test the reliability of the four-group solution derived by the cluster analysis, a discriminant analysis was performed using the cluster variables as predictors of cluster membership. Classification was performed with the "U"-method (i.e., each classification was based on the functions derived from all other cases excluding the case to be classified). The results indicated strong discrimination between the four groups: Of the 171 cases, 96.5% were correctly classified (see Table 5), and 93.6% of the cross-validated (leave-one-out) classifications led to correct assignments of cases to clusters.

Gender Differences in the Cluster Solution

Gender was assumed to moderate the relationship between mood and drinking patterns (Hypothesis 2). In order to test whether men and women were differently distributed over the four clusters, we performed a chi-square analysis. No significant relationships between gender cluster membership was found, $\chi^2 = 2.048$, $df = 3$, $p = .562$.

Hierarchical Linear Modeling of Alcohol Consumption

The analyses reported so far provide insights in the reliability of the cluster solution on aggregate level only ($n = 171$). In addition, it is important to determine the ability of the clusters *to explain inter-individual differences in the within-subject covariations of daily mood and alcohol consumption* (i.e., their effect sizes in the total sample of 94,260 observations). Hierarchical linear modeling was performed to investigate the degree to which the identified drinking styles (clusters) would moderate the relationships between mood and alcohol consumption *in the daily observations collected over the two-year period*. The results of the two-level HLM analyses are summarized in Table 6.

In the first analysis (Step 1), the effects of negative and positive mood on alcohol consumption were tested, controlling for weekend, gender, and current dependence symptoms. Both negative and positive mood states were significantly related to increased alcohol consumption ($\beta_1 = .078$, $s_e = .024$, $t = 3.25$, $p < .002$, and $\beta_2 = .249$, $s_e = .030$, $t = 8.18$, $p < .001$, respectively). Their error variance components indicated significant individual variations around the estimated average slopes.

In the second Step, the dummy coded clusters were entered as (Level-2) predictors of the Level-1 slopes of positive and negative mood on alcohol consumption. Effect coding was used, contrasting each of the first three clusters (emotion-inhibited, positive emotion, and stress drinkers) separately against the fourth cluster. Cluster 4 was chosen as reference because it yielded "emotion-independent drinkers." Thus, Dummy 1, Dummy 2, and Dummy 3 coded Clusters 1, 2, and 3, as "1" and Cluster 4 as "−1", respectively;

In Step 2, the results remained the same for gender (with men drinking significantly more than women, $t = -2.68$, $p<.001$), current dependence symptoms ($t = 4.67$, $p < .001$), and weekend (indicating more drinking on Fridays through Sundays, $t = 13.24$, $p<.001$). However, the

average slopes of positive and negative mood states were no longer significant. Cluster membership displayed significant moderator effects on the Level-1 slopes of positive and negative mood states. Compared to the grand mean in the sample Cluster 1 (emotion-inhibited drinkers) showed less drinking on days with increased negative or positive mood ratings ($\gamma_{11} = -.538$, $s_e = .057$, $t = 9.44$, $p < .001$, and $\gamma_{21} = -.353$, $s_e = .069$, $t = 5.14$, $p < .001$, respectively). Compared to the grand mean, Cluster 2 members ("positive emotion" drinkers) drank significantly more on days with increased positive mood ratings only ($\gamma_{22} = .424$, $s_e = .042$, $t = 10.22$, $p < .001$). Finally, Compared to the grand mean, Cluster 3 members (stress drinkers) drank significantly more on days characterized by negative mood ($\gamma_{13} = .320$, $s_e = .056$, $t = 5.76$, $p < .001$) and less on days characterized by enhanced positive mood $\gamma_{23} = -.240$, $s_e = .069$, $t = -3.50$, $p < .001$).

Effect sizes for cluster variable were calculated according to equations (5) and (6). Including cluster membership as Level-2 predictors of the Level-1 slopes of negative and positive mood reduced their random error variance components considerably (see Table 6). The variance component of β_1 (negative mood) was reduced for 40.57%, which was significant with $\Delta\chi^2 = 408.4$, $p < .0001$, and the variance component of β_2 (positive mood) was reduced for 38.10% with $\Delta\chi^2 = 3972.5$, $p < .0001$.

Stress Drinking and Drinking Problems

According to Hypothesis 3, stress drinkers were expected to be the more heavy drinkers and more likely to display symptoms of abuse and dependence. A MANCOVA was performed using cluster membership as predictor of alcohol consumption, lifetime and current dependence symptoms, and lifetime abuse symptoms, controlling for age and gender. The multivariate effect of cluster was significant (Wilk's Lambda = .848, $F_{(12, 426)} = 2.288$, $p < .008$). Table 7 displays descriptive statistics, univariate results, and effect sizes. In all outcome variables, Cluster 3 showed the highest means. However, cluster membership failed to predict alcohol consumption in this sample. Although stress drinkers (Cluster 3) displayed, on average, slightly higher levels of drinking, with differences between 23 and 41 ml of alcohol per day compared to the other clusters, the effect of cluster group was not significant ($F_{3,165} = .262$, $p = .852$).

However, significant cluster effects were found for lifetime and current dependence symptoms ($F_{3,165} = 6.538$, $p < .001$, and $F_{3,165} = 7.087$, $p < .001$, respectively). Post-hoc comparisons with Bonferroni correction (discarding the covariates) revealed significantly greater symptoms among stress drinkers compared to enhancement drinkers (Cluster 2) and emotion-independent drinkers (Cluster 4, all $p < .01$). No differences were found in comparison to Cluster 1 (emotion-inhibited drinkers). Cluster membership also predicted lifetime abuse symptoms ($F_{3,167} = 3.059$, $p < .03$); in post-hoc tests, Cluster 3 showed greater mean scores in comparison to Cluster 2 only ($p < .032$, one-tailed). Because of a substantial number of missing values in current abuse symptoms ($n = 112$ only), this outcome was analyzed in a separate ANCOVA. Cluster membership did not predict this outcome. Cluster membership accounted for 10 to 11.5% of the variance in lifetime and current dependence symptoms and explained between 5 and 6% in lifetime and current abuse symptoms.

Discussion

This study examined co-variations of mood and alcohol consumption in a sample of light, medium, and heavy alcohol consumers who provided daily self-reports over a period of two years. Our results add to the limited literature on within-subject relationships between emotional states and alcohol consumption and confirm once more that findings on the between-subject level cannot be generalized to within-subject correlations of mood and drinking (Affleck et al., 1999; Tennen et al., 2000). On both within- and between-subject levels, correlations of mood and drinking did not differ significantly from zero. However, on between-

subject level, correlations varied significantly by gender. Among women, those with higher average levels of sadness, anger, and stress reported higher levels of alcohol consumption; among men, those with higher negative mood ratings reported significantly less alcohol consumption.

Between-subject correlations do not answer the critical question whether a person tends to drink more in certain mood states and less in others. Hypotheses regarding covariations of mood and drinking require within-person analyses instead (Affleck et al., 1999; Carney et al., 2000; Hussong et al., 2005; Litt, Cooney, & Morse, 1998; Mohr et al., 2000; Swendsen et al., 2000; Tennen et al., 2000). On within-subject level, no general relationship between mood and drinking was found, but individual results varied considerably. Cluster analysis was used to extract four distinct groups of alcohol consumers. Cluster 4 established the largest group with 78 participants (45.6%) showing no correlation between mood and drinking. Cluster 2 was the second largest cluster with 69 participants (40.4%) showing more drinking on days characterized by positive mood. Clusters 1 and 3 comprised only 12 subjects (7.0%) each. Cluster 3 was of particular interest in this study because its members drink more on days with high stress, anger, and sadness ratings, and thus fit best into the theoretically expected, clinically relevant pattern of stress relief and coping motivated drinking.

One shortcoming of this study is that it does not support causal conclusions. Although this is true for any correlational research, many investigators like to approach the question of causality by establishing different time frames for the assessment of mood and drinking that allow linking mood states to subsequent alcohol consumption. However, in this study, both alcohol consumption and mood were assessed simultaneously as “summary reports” for the day preceding the call to the IVR system, without establishing different time frames for mood and drinking.[3] Thus, any causality in the pattern of covariations established in this study must remain an open question. Although theoretical models emphasize the causal impact of (mostly negative) emotional states on alcohol consumption (M. L. Cooper et al., 1995;Sayette, 1993;Steele & Josephs, 1988), the covariations of mood and drinking established in our study could equally point into the opposite direction, indicating effects of alcohol consumption on subsequent mood states. However, in the case of Cooper’s motivational model of alcohol use, such a reversal of causality would still fit into the theoretically expected pattern at least for the cluster of “positive mood drinkers.” Assuming “enhancement motives” as the driving force behind this drinking pattern, positive mood could both elicit as well as result from alcohol consumption and still be in line with the causal assumptions.

Temporal sequencing appears more important for testing the direction of causality among so-called “stress drinkers” (Cluster 3). Because our study fails to provide for such lagged analyses, assumptions regarding the direction of causality can only be supported by strong theoretical models. Both motivational and learning models of human behavior implicate that behaviors occur for their positive consequences. Thus, on the background of these models, a pattern of “stress drinking” could only be rationally explained in terms of negative reinforcement. These models would not support the notion of a long-term pattern of drinking consistently followed by increased negative mood.

From a theoretical point of view, the pattern displayed by Cluster 1 (emotion-inhibited drinking) appears most surprising and difficult to explain. We expected a co-existence of coping and enhancement motives in some individuals, and thus, a cluster with overall positive correlations between mood and drinking. We found negative correlations instead. One possible explanation might be that some alcohol consumers drink most when bored and, thus, less when

[3]We did perform lagged analyses, correlating mood states to alcohol consumption on the subsequent day. However, no correlational pattern or cluster groups could be established in these lagged analyses.

emotionally aroused, regardless of the quality of the mood state experienced. However, this hypothesis requires further investigation.

With regard to gender (Hypothesis 2), we could not substantiate moderating effects on the within-subject correlations or the cluster solution derived from these correlations. However, we found gender differences in the overall amount of drinking as well as differences in the associations of mood and alcohol consumption on between-subject level. Alcohol consumption was significantly lower among women, as reported many times in the literature (Holmila & Raitasalo, 2005). Further, only among women, those with higher average levels of sadness, anger, and stress reported higher levels of alcohol consumption; among men, those with higher negative mood ratings reported significantly less alcohol consumption. These results deviate from earlier findings in the literature reporting greater associations between negative mood or stress and alcohol consumption among men. For example, Cooper et al (M. L. Cooper et al., 1992) found a relationship between stressors and drinking only in a subgroup of men with ineffective coping styles but no such relationship among women. Similarly, both Frone et al. (Frone et al., 1994) and Dawson et al. (Dawson et al., 2005) reported stronger effects of stressful life events on alcohol use among men. The discrepancies in our results might be due to the different stress measures used in our study; we assessed stress on emotional level whereas the cited studies focused on stressful life events.

Two questions were raised regarding the cluster solution that we extracted from the within-subject correlations. First, how reliable is the cluster solution? And second, how much random variation in the slopes of positive and negative mood on alcohol consumption does cluster membership explain?

Using discriminant analysis, we determined that 96.5% of the cases could be correctly classified. In all clusters, maximally two members (n = 6 out of 171) were misclassified. The most reliable cluster was Cluster 3, with all 12 cases correctly classified. Overall, the cluster solution appeared highly reliable and is likely to be valid, given that within-subject correlations were computed over an average of 670 repeated observations, leaving little room for within-person sampling error.

Hierarchical linear modeling was used to determine the degree to which cluster membership accounted for random variation in the slopes of positive and negative mood states on daily drinking. Controlling for gender, dependence symptoms, and weekly variations in drinking, cluster membership explained between 38 and 40.5 percent in the random variation of the slopes. This is an impressive effect size and points once more to the efficiency of the cluster solution in capturing inter-individual differences in the within-person correlations of mood and drinking. However, a significant amount of random variation remained unexplained, leaving room for a variety of moderating factors that are discussed in the literature but were not included in this study (Sayette, 1999; Steptoe & Wardle, 1999; Swendsen & Merikangas, 2000; Young et al., 1990).

Finally, we tested the hypothesis that stress drinkers are more likely to display signs of problem drinking. As expected, Cluster 3 (stress drinkers) had the highest means in alcohol consumption and symptoms, but only the analyses on abuse and dependence symptoms were significant. With regard to lifetime and current dependence symptoms, Cluster 3 differed significantly from Clusters 2 and 4 only, but not from Cluster 1 (emotion-inhibited drinkers). These results lend some support to the hypothesis that stress drinkers are at increased risk of slipping into problem drinking, dependence, abuse, and alcohol-related health hazards. However, our results also indicate that the group of stress drinkers is relatively small (7%) in a population of non-clinical, regular alcohol consumers varying considerably in their levels of consumption between light and heavy drinking.

In sum, the current study adds to the literature on mood and drinking in two regards. The strength of this study builds on the relatively large sample size in combination with a two-year daily self-reporting period, which is unique in the literature. Shorter time periods that are more commonly reported in the literature might be limited by reactivity of the measures that is likely to occur during the initial phase of a longitudinal study. Indeed, we have some evidence that such reactivity occurred in at least a part of the sample, as indicated by a temporary reduction in alcohol consumption during the first weeks of the study. Further, considerably shorter time periods might not provide sufficient data points to allow the derivation of a reliable individual drinking pattern in a limited number of drinking occasions reported.

Second, the analytical approach chosen in this study is unique since no previous study has attempted to cluster within-person correlations of mood and drinking. In addition, we investigated the simultaneous effects of positive and negative mood states on alcohol consumption in the same model, which is important in order to gain full insights in the relationships between diverse mood states and drinking. This is unique in the literature and defines an additional strength of this study. The results indicate that stress drinking might apply only to a minor part of the population under investigation, and that a considerable part of this population does not exhibit any relationship between mood and drinking.

Some limitations need to be mentioned. First, the sample was restricted to Vermont light, medium, and heavy alcohol consumers who were not in treatment for alcohol-related problems, and, as such, do not represent a population of clinical cases. Second, because mood was assessed as a daily summary report, the covariations detected in this study cannot be interpreted in terms of mood as the antecedent and drinking as a potential response to emotional arousal. However, at least with regard to stress-related drinking, reinforcement theories point strongly in the direction of stress or negative mood as the precursor of drinking behavior (Armeli et al., 2003; M. L. Cooper et al., 1995; Todd et al., 2005; Wilkie & Stewart, 2005). Whether the clusters detected in this study are linked to corresponding drinking motives and, thus, point to a causal pattern has to be tested in future research. Third, self-selection of subjects had taken place during both recruitment and drop-out. Thus, generalizability to populations less willing to participate in such longitudinal research is an open question that needs further investigation. Further, the cluster solution might not generalize to other measures or assessment methods than the ones applied in this study.

Finally, the results of this study warrant caution in discounting between-person relationships in favor of within-person correlations between mood and alcohol consumption. Certainly, in a process-oriented design, only the latter seems of interest. However, given that regular heavy drinking might inflate any co-variation with potential antecedents, and given that within-person correlations typically ignore interindividual differences in levels of drinking, as well as their association with averaged stress and mood, we would like to encourage an integrated view of both within-person and between-person analyses. Only in combination can within-person and between-person analyses provide a comprehensive picture of the relationships between alcohol consumption and its psychosocial predictors.

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Table 1

Demographics

	Males *n*=92		Females *n*=81			total *N*=173	
	M	***SD***	***M***	***SD***	***t*-test**	***M***	***SD***
Age (21–74)	43.7	11.8	40.6	11.7	1.72	42.3	11.9
Number of years of education	14.0	2.1	14.1	2.2	−0.55	14.0	2.1
Current dependence symptoms (0–7)	2.6	2.0	2.1	2.0	1.75	2.4	2.0
Lifetime dependence symptoms (0–7)	3.8	2.0	3.2	2.2	1.89	3.6	2.1
Current abuse symptoms (0–4)	0.9	0.9	0.7	0.8	1.30	0.8	0.9
Lifetime abuse symptoms (0–4)	1.9	1.2	1.4	1.2	2.73**	1.6	1.2
Marital Status	*n*	%	*n*	%	Chi^2	*n*	%
Married	42	46	35	43	0.26	77	45
Separated/Widowed/Divorced	27	29	23	28		50	28
Never Married	23	25	23	28		46	27
Ethnic Minority							
Yes	91	99	78	96		4	2
No	1	1	3	4		269	98
Income							
<=20,000	19	21	17	21	3.84	36	21
20,001–30,000	13	14	17	21		30	17
30,001–40,000	13	14	10	12		23	13
40,001–50,000	10	11	12	15		22	13
50,001–75,000	22	24	18	22		40	23
>75,000	15	16	7	9		22	13
Number of Children							
0	29	32	32	40	1.37	61	35
1	13	14	11	14		24	14
2	32	35	23	28		55	32
>=3	18	20	15	19		33	19
Religion							
Protestant	27	29	22	27	6.16	49	28
Catholic	30	33	20	25		50	29
Other	6	7	15	19		21	13
None	29	32	24	30		53	31
Importance of Religion							
Very important	13	14	14	17	2.64	27	16
Somewhat important	24	26	26	32		50	29
Somewhat unimportant	26	28	24	30		50	29
Very unimportant	29	32	17	21		46	26

Table 2

Grand Means and Standard Deviations of Emotional States and Alcohol Consumption

Variable and Range	All (*N*=173)		Male (*n*=92)		Female (*n*=81)		Effect of Gender	
	M	*SD*	*M*	*SD*	*M*	*SD*	*t*	*p*
Anger (0–7.0)	1.8	1.5	1.5	1.4	2.2	1.6	2.87	.005
Sadness (0–8.2)	2.2	1.9	1.7	1.6	2.7	2.0	3.53	.001
Stress (0–7.6)	2.9	1.8	2.5	1.6	3.4	1.9	3.41	.001
Happy (0.2–9.6)	6.0	1.6	5.9	1.5	6.1	1.8	0.84	.403
Rateday (2.2–8.9)	6.2	1.3	6.2	1.2	6.2	1.4	0.15	.884
Average negative emotions[1]	−.02	0.8	−0.2	0.7	0.2	0.8	3.51	.001
Average positive emotions[1]	−.01	0.8	−0.0	0.7	0.0	0.8	0.55	.584
Av. # drinks per day (0.2– 16.2)	3.5	3.0	4.4	3.2	2.5	2.4	4.98	.000

[1]Note: Average positive emotions were calculated as the sum score of the z-transformed “happy” and “rateday” items. Average negative emotions were calculated as the sum score of the z-transformed “anger,” “sadness,” and “stress” items.

Table 3

Between-subject Correlations of Emotional States and Alcohol Consumption, Using Individual Mean Scores from 735 Days of Repeated Measures, Separately by Gender

	All (*n*=173)	**Male *n*=92**	**Female *n*=81**	***t* (*df*=167)**	***p***
Stress	−.08	−.21*	.24*	2.93	.01
Anger	−.05	−.19	.24*	2.79	.01
Sadness	−.04	−.17	.27*	2.93	.01
Happy	−.10	.00	−.17	1.15	*ns*
Rateday	−.14	−.08	−.23*	1.00	*ns*
Negative Emotions	−.06	−.21*	.27*	3.12	.01
Positive Emotions	−.12	−.04	−.20	1.09	*ns*

Note: Alcohol consumption was normalized using the log10 (x+1) transformation. Outliers in the emotional predictors were trimmed to z < |±3*sd*|

* *p*<.05

Table 4

Within-subject Correlations of Emotional States and Alcohol Consumption from Daily Self-reports, separately by Gender

	All *n* = 171			Male *n*=90			Female *n* = 81		
	Min.	**Max.**	**Mean[1]**	**Min.**	**Max.**	**Mean[1]**	**Min.**	**Max.**	**Mean[1]**
Sadness	−.45	.42	−.02	−.45	.42	−.03	−.35	.31	−.00
Anger	−.40	.37	−.01	−.40	.21	−.02	−.31	.37	.01
Stress	−.50	.45	−.03	−.50	.45	−.03	−.30	.38	−.02
Happy	−.41	.39	.10	−.41	.37	.10	−.30	.39	.11
Rateday	−.42	.50	.11	−.42	.50	.12	−.32	.42	.10
Negative Emotions	−.50	.46	−.02	−.50	.46	−.03	−.35	.42	−.01
Positive Emotions	−.44	.48	.12	−.44	.48	.12	−.32	.39	.11

[1] Means were calculated using Fisher's z transformation of the individual correlations.

Gender differences not significant.

Table 5

K-Means Cluster Analysis of Within-subject Correlations between Emotional States and Alcohol Consumption: Average Correlations per Cluster (n=171)

		Cluster			
		1	**2**	**3**	**4**
Sadness		−.21	−.07	.28	.02
Anger		−.15	−.07	.20	.04
Stress		−.20	−.10	.26	.02
Happy		−.12	.25	−.22	.06
Rateday		−.07	.27	−.26	.06
Negative Emotions		−.23	−.11	.32	.03
Positive Emotions		−.11	.29	−.26	.07
Number of cases		12	69	12	78
Correctly classified in DA[1]	*n*	10	67	12	76
	%	83.3%	97.1%	100%	97.4%

[1]Discriminant Analysis; overall correct classification into clusters: 96.5%

Table 6

Hierarchical Linear Modeling Results

Level 1 Predictors	Level 2 Predictors	Final Estimation of Effects: Estimate	*SE*	*t*	Variance components (σ^2_U) of Level 2 random effects (errors): σ^2_U	*df*	*Chi*^{2}	Comparison of variance components (df = 3): % Reduction	Δ*Chi*^{2}
STEP 1									
Intercept (β_0)	Gender (γ_{01}) [a]	−.457	.114	−4.02***	.884	168	149013***		
	Dependence Symp. (γ_{02})	.129	.028	4.54***					
Negative Mood (β_1)	Intercept β1 (γ_{10})	.078	.024	3.25**	**.092**	**170**	**5108*****		
Positive Mood (β_2)	Intercept β2 (γ_{20})	.249	.030	8.18***	**.153**	**170**	**10198*****		
Weekend (β_3)	Intercept β3 (γ_{30})	.430	.032	13.25***	.175	170	10410***		
STEP 2									
Intercept (β_0)	Gender (γ_{01}) [a]	−.409	.111	−3.68***	.886	168	149589***		
	Dependence Symp. (γ_{02})	.130	.028	4.67***					
Negative Mood (β_1)	Intercept β1 (γ_{10})	−.004	.027	−0.15	**.055**	**167**	**4699*****	**40.57**	**408.4*****
	Cluster Dummy 1 (γ_{11})	−.538	.057	−9.44***					
	Cluster Dummy 2 (γ_{12})	.052	.034	1.52					
	Cluster Dummy 3 (γ_{13})	.320	.056	5.76***					
Positive Mood (β_2)	Intercept β2 (γ_{20})	.041	.034	1.23	**.095**	**167**	**6226*****	**38.10**	**3972.5*****
	Cluster Dummy 1 (γ_{21})	−.353	.069	−5.14***					
	Cluster Dummy 2 (γ_{22})	.424	.042	10.22***					
	Cluster Dummy 3 (γ_{23})	−.240	.069	−3.50***					
Weekend (β_3)	Intercept β3 (γ_{30})	.430	.032	13.24***	.175	170	10408***		

** Note: $p < .01$;

*** $p < .001$

[a] Gender coded as 1=male, 2=female.

Cluster coding: Dummy 1, Dummy 2, and Dummy 3 coded Clusters 1, 2, and 3, as "1" and Cluster 4 as "−1", respectively;

Cluster 1: Emotion-inhibited drinking; Cluster 2: Positive emotion drinking; Cluster 3: Stress Drinking; Cluster 4: Emotion-independent drinking.

Bold: Coefficients compared in Steps 1 and 2.

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Table 7

MANCOVA/ANCOVA Testing Cluster Effects on Alcohol Symptoms, Controlling for Age and Gender: Descriptive Statistics and Univariate Results

	Cluster 1: Emotion-inhibited drinking		Cluster 2: Positive emotion drinking		Cluster 3: Stress drinking		Cluster 4: Emotion-independent drinking		
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	$SDF_{(3,165)}$ [a]	Eta^2
Alcohol consumption (drinks/day)	3.41	3.29	3.30	3.16	3.71	3.13	3.48	2.530.262	.005
Lifetime dependence symptoms	4.00	2.17	3.21	1.91	5.67	1.88	3.54	$2.13_{6.538}$***	.107
Current dependence symptoms	3.08	2.19	2.03	1.82	4.42	1.93	2.36	$1.96_{7.087}$***	.115
Lifetime abuse symptoms	1.58	1.24	1.43	1.12	2.42	1.24	1.72	$1.30_{3.059}$*	.053
Current abuse symptoms [a]	.86	1.07	.79	.74	1.67	1.63	.78	.912.268	.061

* $p < .05$;

*** $p < .001$.

[a] Current abuse symptoms were tested in a separate univariate ANCOVA because of missing data ($N = 112$, $df_{error} = 106$).