Published in final edited form as:
Addict Behav. 2011 March ; 36(3): 197–202. doi:10.1016/j.addbeh.2010.10.005.

Ups and Downs of Alcohol Use among First-year College Students: Number of Drinks, Heavy Drinking, and Stumble and Pass out Drinking Days

Jennifer L. Maggs, Ph.D.[1], **Lela Rankin Williams, Ph.D.**[2], and **Christine M. Lee, Ph.D.**[3]
[2]Arizona State University, School of Social Work, 411 N. Central Ave. Suite 800, Phoenix, AZ 85004-0689

[3]University of Washington, Department of Psychology, Box 351525 Seattle, WA 98195-1525

Abstract

Given the dynamic fluctuating nature of alcohol use among emerging adults (Del Boca, Darkes, Greenbaum, & Goldman, 2004), patterns of alcohol use were modeled across 70 days in an intensive repeated-measures diary design. Two hundred first-year college students provided 10 weekly reports of their daily alcohol consumption via computer-assisted telephone interviews. Multi-level models demonstrated large within-person variability across days in drinks consumed, binge drinking, and days exceeding self-reported limits for stumbling around and passing out; these outcome variables were predicted by weekdays vs. weekend days (within-person) and gender, age of drinking initiation, fraternity/sorority membership, and alcohol motivations (between-persons). Repeated measurement of alternate indicators of alcohol use permits the examination of novel and important questions about alcohol use and abuse particularly in young adult and other erratically drinking populations.

Keywords

repeated-measures; alcohol use; emerging adults; daily diary

Ups and Downs of Alcohol Use among First-year College Students: Drinks per Day, Heavy Drinking, and Stumble and Pass out Drinking

Temporal patterns of variability in alcohol use across days and weeks are receiving increased attention (e.g., Del Boca, Darkes, Greenbaum, & Goldman, 2004). Nesselroade (1991, 2004) distinguished three types of variability in developmental and clinical data. Interindividual differences include between-person differences at one time as well as stable traits such as gender. Intraindividual change represents enduring, cumulative gains or losses,

[1]Correspondence concerning the handling of the paper should be sent to Jennifer L. Maggs, Human Development and Family Studies, S-110-D Henderson South, Pennsylvania State University, University Park, PA 16802, jmaggs@psu.edu, 814 865 2028 tel 814 863 6207 fax.
Institution of origin: University of Arizona, Norton School of Family and Consumer Sciences, 650 N. Park Ave PO Box 210078 Tucson, AZ 85721-0078

such as language acquisition. Intraindividual variability consists of relatively reversible fluctuations, such as ebbs and flows in affect (see also Molenaar, 2004). Each may have similar or differing underlying causes and short- and long-term consequences for health and development.

In this paper, we argue that all three sources of variability in substance use are of pivotal importance to scientists and clinicians. Longitudinal research shows an average pattern where alcohol use rises and then falls across adolescence and early adulthood (Bachman, Wadsworth, O'Malley, Johnston, & Schulenberg, 1997); interindividual differences in trajectories have been identified (e.g., Chassin, Pitts, & Prost, 2002; Schulenberg, O'Malley, Bachman, Wadsworth, & Johnston, 1996). Because fluctuations in alcohol use are pronounced among young adults (Chen & Kandel, 1995), and because acute consequences are affected more by intensity than frequency (Rehm, Greenfield, & Rogers, 1996), there is new interest in modeling patterns of alcohol use variability (e.g., Greenbaum, Del Boca, Darkes, Wang, & Goldman, 2005; Hussong, Hicks, Levy, & Curran, 2001; Tennen, Affleck, Armeli, & Carney, 2000). In the present study, we examine between-person differences in variability in alcohol use across 70 days among first-year college students.

1.1 Why Measure Fluctuations in Alcohol Use?

National public health surveys are ideal for estimating prevalence, but miss possible infrequent heavy drinkers and provide no information about patterns of use across days, weeks, or months. If alcohol use or heavy drinking is erratic, short assessment windows may misclassify individuals (Chen & Kandel, 1995; Lemmens, Tan, & Knibbe, 1992) and fail to identify important situational determinants of risky behaviour with important implications for environmentally-based harm reduction.

Del Boca and colleagues (2004) examined temporal variability in college students' alcohol use across one academic year. Using timeline follow-back (TLFB) methods to assess drinking across seven 30-day periods, this innovative paper demonstrated sizeable variability across weeks that rose and fell with holidays, academic demands, and day of week (heaviest on Thursday through Saturday). These results demonstrated that in addition to stable and developmentally-changing risk factors, there may also be powerful immediate and situational influences.

Traditional longitudinal studies are designed to detect slow and cumulative change (Martin & Hofer, 2004). Measures assess typical behaviours at each wave, assuming short-term stability of behaviour. When respondents estimate their actions in the past month or year, researchers assume that this behaviour has a typicality, that respondents remember its frequency and intensity, and that they can average this information accurately (Lemmens et al., 1992). However, if patterns fluctuate significantly across occasions, an incomplete or inaccurate picture may be obtained. Within-person variability may have lawful antecedents that should be reflected in etiological models and targeted by prevention (de Weerth, van Geert, & Hoijtink, 1999; Searles, Perrine, Mundt, & Helzer, 1995).

Focusing on intraindividual variability in alcohol use among 18- and 19-year-old college students across 70 days, the present aims were to: (1) describe and compare within-person daily fluctuations in alcohol use with between-person differences in alcohol use; (2) model patterns of day-to-day fluctuations in alcohol use using multi-level models; and (3) assess the extent to which fluctuations in drinking across days were predicted by known between-person risk factors for heavy drinking (gender, age of drinking initiation, fraternity/sorority membership, alcohol motivations). This paper extends Del Boca and colleagues' (2004) examination of variability across *weeks* using data about fluctuations in alcohol use and heavy drinking across 70 *days*.

2. Methods

2.1 Participants and Design

Participants were first-year students at a large public college in the United States. The summer prior to their first year, 943 (54% women, 98% response rate) completed paper and pencil surveys. The study was conducted in accordance with professional ethical guidelines. Incentives were T-shirts and raffle tickets for $20 prizes. In the second semester (spring, about 7 months later), 202 students from the original 943 participated in a telephone diary interview study. Eligible participants were: (1) first-year students (96% of summer sample); (2) < 21 years (99.8%); (3) living on campus (86%); (4) non-abstainers from alcohol during their final year in secondary school (79%); and (5) willing to be re-contacted (65%). Analyses comparing those who agreed to be contacted and those who did not showed no differences on demographic or psychological variables. Approximately 80% of those contacted for the diary study participated.

Students were telephoned weekly for 10 weeks across the Spring semester assisted by computerized interview software. Modified TLFB procedures assessed 7-day retrospective reports of drinking. The final sample averaged 18.8 years (*SD*=.4), 63% were female, and 84% self-identified their ethnicity as white, non-Hispanic. Incentives were raffles for prizes from local merchants and $20 at the end of the study. Of an original 202 students, 2 completed only one interview and are not included. In total, 96% of the interviews were completed (1937 of 2020 possible).

2.2 Measures

2.2.1 Early drinking initiation—A median split distinguished students who initiated use of alcoholic beverages—more than just a few sips—prior to ninth grade (approximately age 14; coded as 1) versus later (see e.g., Muthén & Muthén, 2000b).

2.2.2 Fraternity/sorority membership—Members (33%) of student fraternity and sorority organizations (historically associated with parties and heavier alcohol use; known as Greek clubs due to being named for Greek letters) served as the reference group in contrast to students who had wanted to join but did not (30%) and who never planned to and did not join (37%). (No student who expressed no interest in joining at Orientation subsequently joined a Greek organization.) These dummy codes were designed to contrast selection versus Greek ‘effects’ on alcohol use.

2.2.3 Alcohol motivations—Two subscales of the Importance of Consequences of Drinking short form (Maggs, Vesterdal, & Galambos, 2005) assessed the importance of achieving fun-social alcohol effects (4 items, α=.94) and of avoiding physical-behavioural alcohol effects (5 items, α=. 94). In a series of college samples, Maggs et al. demonstrated the internal consistency, test-retest reliability, and concurrent/predictive validity of the ICOD long form. Item-response theory analyses were used to create optimal short forms that maintain the reliability, factor structure, and validity.

2.2.4 Alcohol use—Modified TLFB methods (e.g., Sobell & Sobell, 1992) assessed retrospective reports of the number of drinks consumed on each of the prior 7 days. A drink was defined as a bottle or glass of beer, shot of liquor, mixed drink, glass of wine, or wine cooler. Retrospective diaries under 14 days (e.g., Wennberg & Bohman, 1998) have important benefits: (a) compared to prospective diaries, they are less reactive and burdensome to respondents; (b) compared to quantity-frequency measures, no mental aggregating is required; and (c) compared to longer-term retrospective recall, they have

higher reliability and validity and better identify high-risk use (Lemmens et al., 1992; Webb, Redman, Sanson-Fisher, & Gibberd, 1990; Werch, 1990).

Four alcohol use outcomes were computed. *Drinks per Day* represented the raw reports of drinks consumed on each of the assessed days. *Heavy Drinking Days* were computed as a dichotomous daily indicator of consuming 4 or more drinks (women) or 5 or more drinks (men) on a given day (heavy drinking days=1 [13% of days]; non-heavy drinking days=0). In one interview only, students were asked to estimate how many drinks it would take for them to: feel different, feel dizzy, stumble around in an uncoordinated manner, and fall asleep when they did not want to (Schuckit, Tipp, Smith, Wiesbeck, & Kalmijn, 1997). We coded whether, on each of the 70 days, students had met or exceeded their own personal limit for stumbling around (*Stumble Days*; 4% of days) and for falling asleep when they didn't want to (*Pass Out Days*; 1.5% of days). These measures in part reflect perceived differences in individual alcohol tolerance levels. We focused on these latter two in analysis because these higher thresholds were most conceptually different from the quantity-based drinks per day and heavy drinking measures and they represent levels of use clearly likely to cause significant short- or long-term harm.

2.2.5 Day of week—Weekdays (Sunday to Wednesday=0) were contrasted with weekends (Thursday to Saturday=1), based on research (e.g., Del Boca et al., 2004) and local college culture.

3. Results

3.1 Descriptive Statistics

Figure 1 plots alcohol use by day of week: 5–6% of the total alcohol was consumed on each of Sunday through Wednesday, 17%/31%/30% on Thursday through Saturday. Figure 2 presents the percent of days reaching three heavy drinking thresholds, with a very similar pattern. Across 10 weeks, 48% reported drinking heavily on at least one weekday and 76% drank heavily on at least one weekend day. For stumble days (passing out days), 28% (14%) drank to this threshold at least one weekday and 57% (29%) did so on at least one weekend day.

3.2 Daily Fluctuations Within Person vs. Stable Differences Between People (Aim 1)

Multi-level models were computed (Raudenbush & Bryk, 2002). Models for drinks per day assumed a continuous normal distribution, and models for dichotomous outcomes assumed a binomial (Bernouilli) distribution (Raudenbush & Bryk, 2002). Baseline unconditional models provided point estimates of means and the relative size of between- versus within-person differences (not tabled). A grand mean for *drinks per day*, γ_{00}, of 1.02 (*SE*=.08), $p<.001$, indicated that the average student consumed just over 7 drinks per week. Random effects showed significant between-person variability around this grand mean, $\chi^2=2719.5$, $df=180$, $p<.001$. The intra-class correlation (ICC)[1], $r = .168$, indicated that about 1/6 of the variance was between-person and about 5/6 was within-person (Raudenbush & Bryk, 2002). Thus, there was meaningful variability both comparing different students and comparing different days within students.

Fixed effects for *heavy drinking* revealed that the odds of heavy drinking on a given day were .073 (*CI*=0.058, 0.092), $p<.001$, or, less than 1 in 14 days ($1 \div 14 = .071$). Random effects showed significant between-person variability, $\chi^2=2803.1$, $df=180$, $p<.001$, and the ICC[2], $r = .388$, indicated that about 3/5 of the variance was within-person. The odds of a

[1]ICC for continuous outcomes = $\tau/\sigma^2 + \tau$ (Raudenbush & Bryk, 2002).

stumble day were were. 023 (*CI*=0.018, 0.029), $p<.001$, or about once in six weeks, with significant between-person differences, $\chi^2=1407.0$, $df=180$, $p<.001$, and an ICC of $r = .332$, indicating that 2/3 of the variance was within-person. The odds of a *pass out day* were .009 (*CI*=0.007, 0.012), $p<.001$, or about 3 times a year, with significant between-person differences, $\chi^2=602.5$, $df=176$, $p<.001$, and an ICC of $r=.313$, indicating that about 2/3 of the variance was within-person.

These unconditional models demonstrated meaningful proportions of within-person fluctuations in alcohol use, as well as significant between-person differences. Point estimates of average consumption, however, do not describe drinking patterns or individual differences. To this end, we added predictors of within-person fluctuations and between-person differences.

3.3 Modeling Weekday vs. Weekend Patterns (Aim 2)

To compare weekday vs. weekend alcohol use, we added a time-varying (Level 1) predictor. Number of drinks per day for each person was modeled as the average number of drinks consumed on the average weekday, β_{0i}, plus the increment in drinks consumed per average weekend day, β_{1i}, plus within-person fluctuations across the 14 days around that individual mean, r_{it}. At Level 2, these two coefficients were modeled as the grand means for weekday and weekend drinks per day, γ_{00} and γ_{10}, plus between-person differences around these, u_0 and u_1. Similar models were tested for heavy drinking, stumble days, and pass out days.

Results showed significant effects of day of week for all four outcomes. The average student consumed .40 drinks on the average weekday. On the average weekend day, this increased by 1.45 drinks to 1.85 for the average student. The odds of heavy drinking on a weekday were .018 (*CI*=. 014–.024, $p<.001$), or on about 1 in 55 weekdays. On weekend days, students were 8.837 (*CI*=.006–.011, $p<.001$) times more likely to engage in heavy drinking, increasing the probability to .177, about once per two weekends. The odds of a stumble day on a weekday were .008 (*CI*=.006-.011, $p<.001$), or less than 1 of 125 weekdays. The odds of a stumble day were 5.466 (*CI*=4.368–6.840, $p<.001$) times greater on weekend days, at about 4 percent. The odds of a pass out day on a weekday were .004 (*CI*=.003–.005, $p<.001$), or less than 1 weekday per year. On weekend days, students were 4.188 (*CI*=2.943–5.958, $p<.001$) times more likely to have a pass out day, raising the probability to about 1½ percent on any given weekend day, or on about 3½ weekend days per year.

3.4 Predicting Individual Differences in Alcohol Use on Weekdays and Weekend Days (Aim 3)

3.4. 1 Drinks per day—Averaged across the 40 weekdays, the reference group (women, late drinkers, Greek members, and students with average alcohol motivations) reported drinking about 1/3 of a drink per weekday (see Table 1). An additional 1/4 drink per weekday was consumed by men and by individuals who began drinking alcohol before ninth grade. Students who never planned to join the Greek system drank 1/4 drinks fewer per weekday than Greek members. Finally, for each standard deviation increment in negative physical-behavioural motivations, students drank 1/5 fewer drinks per weekday.

The reference group drank 1.4 drinks more per weekend day. Approximately 3/5 of a drink more per day was consumed both by men and by early drinking initiators. Students who did not plan to join Greek clubs drank almost 9/10 of a drink less per weekend day, and those who had wanted to join but did not do so drank just under 1/2 a drink less, both compared to

[2]ICC for dichotomous outcomes, $\tau/[\tau+(\pi/3)]$.

Greek members. Finally, for each standard deviation increment in fun-social motivations, there was an increment of 1/2 drink more per weekend day.

3.4. 2 Heavy drinking—On the average weekday, the reference group had a 2% likelihood of heavy drinking (see Table 2). Men and Greek non-members did not differ in their likelihood of heavy drinking on weekdays compared to women and Greek members, but early drinking initiators were 2.35 times more likely to drink heavily. In addition, for each standard deviation higher in fun-social motivations, students were 70% more likely to drink heavily on a weekday, and for each standard deviation higher in negative physical-behavioural motivations, they were about half as likely to drink heavily.

On the average weekend day, students were 7.6 times more likely to drink heavily. More negative physical-behavioural motivations predicted a higher likelihood of heavy drinking on weekends vs. weekdays. Average increases in heavy drinking on weekend days did not differ by gender, Greek status, or drinking initiation timing.

3.4.3 Stumble days—The likelihood of drinking enough on a weekday to stumble around was. 01, or about two weekdays per year. Never Greeks were about 60% less likely to drink this amount on a weekday, and students with more negative physical-behavioural motivations were 50% less likely to do so for every standard deviation increment on this measure. Early initiators were 80% more likely to have a stumble day on a weekday. Weekday stumble days did not differ by gender, wanting to join Greek clubs, or levels of fun-social motivations. On weekend days, the likelihood of a stumble day was 6¼ times higher than on weekdays, or about once in 6 weeks. This increased likelihood did not differ by any of the between-person predictors.

3.4.4 Pass out days—The likelihood of drinking enough alcohol to pass out on a weekday was. 004. Students were approximately 60% less likely to do so for each standard deviation increment in physical-behavioural motivations. On weekend days, students were 4 times as likely to have a pass out day. There were no other significant between-person predictors.

4. Discussion

Scientific interest and public health concern with respect to university student alcohol use is not new, however the measurement of alcohol use is rapidly evolving in part due to an increased awareness of multiple levels of influence on behaviour (e.g., DeJong & Langford, 2002) as well as new statistical techniques for modeling multi-level variation (e.g., Muthén & Muthén, 2000a; Raudenbush & Bryk, 2002). Traditional categorizations of heavy drinking that assess global behaviour in a short time frame (e.g., 2 weeks, 1 month) may miss important variability in drinking, both during and outside the sampled time period. Many studies have shown that students who engage in heavy drinking are at higher risk for serious negative consequences and behavioral risks (e.g., Neal & Fromme, 2007; Perkins, 2002), however this pattern of drinking may not be consistent throughout an entire week, semester, or academic year (Del Boca et al., 2004). Ignoring the ebbs and flows of drinking leads to a solitary focus on stable or relatively enduring influences, and may neglect important time-varying internal, situational, or relational determinants. Recent research suggests that behavioral risks may be more likely to occur on days when individuals consume more than average, and that certain between-person characteristics can influence this within-person variability (Neal & Fromme, 2007). For example, several studies among college students utilizing diary or event-level comparisons have found that typically lighter drinkers are at particular risk for experiencing negative consequences on occasions of increased alcohol use compared to those who are typically heavier drinkers, placing lighter

drinkers at increased risk on heavy drinking occasions (Lewis, Lindgren, Fossos, Oster-Aaland, & Neighbors, 2009; Lee, Lewis, & Neighbors, 2009; Neal & Carey, 2007; Neal & Fromme, 2007).

The results suggest that drinking fluctuates in meaningful ways from day to day, and in particular from weekday to weekend. There was significant within- and between-person variability in different dimensions of alcohol use across one semester, with approximately two-thirds of the variance in heavy drinking days, stumble days, and pass out days being within-person. Additionally, the great majority (83%) of the variance accounted for in drinks per day was within-person. That is, in this sample students differed more from themselves (across days) than they did from each other (across persons). Consistent with other recent research (Del Boca et al., 2004), students drank much more on weekends, with Fridays and Saturdays together accounting for 60% of all drinks consumed, and Thursdays accounting for an additional 17%. The odds of drinking heavily, enough to stumble around, and enough to pass out were also greater on weekend days.

Fluctuations in drinking across days, that is, the extent to which students' drinking varied from day to day, were predicted by between-person risk factors for heavy alcohol use. Men, early initiators of drinking, and students with stronger fun-social motivations drank more on weekdays, while students never interested in the Greek system and those with stronger physical-behavioural motivations drank less. Although as a general rule, students increased their drinking on weekends, this rise was more pronounced among men and early initiators. Intended and non-Greek members drank less on weekend days compared to students who joined the Greek system. In regards to heavy drinking days and days students reached their personal estimated stumble and pass out thresholds, early drinkers, and students with stronger fun-social motivations were at higher risk for heavy drinking on weekdays. Heavy drinking in general increased on weekends. However, these increases did not differ by between-person predictors with the exception of students with stronger motivations to avoid physical-behavioural effects who increased their drinking more on weekends. This apparently contradictory finding may reflect students who are more concerned about negative physical and behavioural consequences limiting their drinking during the week when they have more responsibilities, but indulging in heavier drinking during the weekend. It is possible that fewer between-person predictors of increased weekend stumble and pass out drinking were observed due to the relatively lower prevalence of stumble and pass out days, compared to the large variance in drinks per day and the relative frequency of heavy drinking.

Diary measures, both prospective and retrospective, are useful measures of alcohol use that provide more accurate data than traditional aggregate measures (e.g., Lemmons et al., 1992; Redman, Sanson-Fisher, Wilkinson, Fahey, & Gibberd, 1987; Werch, 1990). Respondents reported daily consumption for the prior 7 days instead of estimating average use across a longer time frame. A unique aspect of this study was our combination of the subjective intoxication thresholds with the 70 days of drinking data to assess days on which students drank enough that they believed they might stumble or pass out. While these measures are not objective indicators of intoxication, they provide an alternate strategy for controlling for gender, weight, and tolerance, and thus have complementary strengths to absolute ratio and binge drinking measures. Schuckit et al. (1997) demonstrated that individuals can reliably predict the general number of drinks required to experience different effects from alcohol, however, students do not appear to learn from prior experience, as they tend to over-estimate the number of drinks required to experience an effect, even if they have experienced it before (Mallett, Lee, Neighbors, Larimer, & Turrisi, 2006).

Despite the noted strengths, in particular the 70 days of alcohol use data, characteristics of the sample, design, and analyses are not without limitations. First, the single university sample followed across 10 weeks within the first year of post-secondary education limits generalizability. Future research could examine related questions among students of different ages and at institutions with different characteristics (e.g., drinking culture, urban/rural, number of commuting vs. residential students). Second, daily data were not available on varying situational or motivational predictors of use. A major step for future studies would be to examine proximal determinants of variations in drinking across days, such as drinking companions, drinking locations, and campus events (e.g., football).

The results have important implications for understanding and preventing alcohol use and harm among students. Weekly data collection utilizing a 7-day retrospective time line follow-back method is an effective and feasible strategy for modeling fluctuations in alcohol use. Future research could examine whether similar fluctuations and predictors of variability are similar for negative consequences, and whether weekday drinking places an individual at risk for longer term increased harm from drinking (e.g., less likelihood of maturing out later). Intervention studies with college students could utilize a timeline follow-back or retrospective monitoring exercise (e.g., BASICS, Dimeff, Baer, Kivlahan, & Marlatt, 1999), particularly for students at higher risk for weekday high risk drinking, to discuss patterns of use not typically found in retrospective aggregate measures. For example, contexts of drinking, reasons for drinking, and consequences related to weekday drinking can be highlighted and contrasted with weekend drinking. Treatment outcome studies which rely solely on retrospective aggregates of behavior may not effectively capture important changes in behavior, missing important reductions in high-risk behavior. The present design illuminated differences in weekday vs. weekend drinking, as well as characteristics of those most at risk for heavy drinking on particular days. Future research should compare heavy drinking classifications made with traditional measures versus daily or weekly assessments, examine time-varying predictors of fluctuations in alcohol use across days and how these change with age or drinking experience, and test for subgroups of students who are differentially responsive to situational contingencies. Caution should be exercised in generalizing the results from this single cohort at one college to other ages and to other institutions.

Acknowledgments

This work was supported by the Alcoholic Beverage Medical Research Foundation and the National Institute on Alcohol Abuse and Alcoholism [AA013763] to JM.

References

Bachman, JG.; Wadsworth, KN.; O'Malley, PM.; Johnston, LD.; Schulenberg, J. Smoking, drinking and drug use in young adulthood: The impact of new freedoms and new responsibilities. Mahwah, NJ: Lawrence Erlbaum; 1997.

Chassin L, Pitts SC, Prost J. Binge drinking trajectories from adolescence to emerging adulthood in a high-risk sample: Predictors and substance abuse outcomes. Health Psychology 2002;70:67–78.

Chen K, Kandel DB. The natural history of drug use from adolescence to the mid-thirties in a general population sample. American Journal of Public Health 1995;85:41–47. [PubMed: 7832260]

Chou SP, Pickering RP. Early onset of drinking as a risk factor for lifetime alcohol-related problems. British Journal of Addiction 1992;87:1199–1204. [PubMed: 1511233]

DeJong W, Langford LM. A typology for campus-based alcohol prevention: Moving toward environmental management strategies. Journal of Studies on Alcohol 2002 Supplement No. 14:140–147.

Del Boca FK, Darkes J, Greenbaum PE, Goldman MS. Up close and personal: Temporal variability in the drinking of individual college students during their first year. Journal of Consulting and Clinical Psychology 2004;72:155–164. [PubMed: 15065951]

de Weerth C, van Geert P, Hoijtink H. Intraindividual variability in infant behavior. Development Psychology 1999;35:1102–1112.

Dimeff, LA.; Baer, JS.; Kivlahan, DR.; Marlatt, GA. Brief alcohol screening and intervention for college students (BASICS): A harm reduction approach. New York, NY: Guilford Press; 1999.

Greenbaum PE, Del Boca FK, Darkes J, Wang CP, Goldman MS. Variation in the drinking trajectories of freshmen college students. Journal of Consulting and Clinical Psychology 2005;73:229–238. [PubMed: 15796630]

Hussong AM, Hicks RE, Levy SA, Curran PJ. Specifying the relations between affect and heavy alcohol use among young adults. Journal of Abnormal Psychology 2001;110:449–461. [PubMed: 11502088]

Johnston, LD.; O'Malley, PM.; Bachman, JG. National survey results on drug use from the Monitoring the Future study, 1975–2004. Volume I: Secondary school students. Volume II: College students and adults ages 19–45. Bethesda, MD: National Institute on Drug Abuse; 2005. (NIH Publication Nos. 05-5727 & 05-5728)

Lemmens P, Tan ES, Knibbe RA. Measuring quantity and frequency of drinking in a general population survey: A comparison of five indices. Journal of Studies on Alcohol 1992;53:476–486. [PubMed: 1405641]

Lee CM, Lewis MA, Neighbors C. Preliminary examination of spring break alcohol use and related consequences. Psychology of Addictive Behaviors 2009;23:689–694. [PubMed: 20025375]

Lewis MA, Lindgren KP, Fossos N, Oster-Aaland L, Neighbors C. Examining the relationship between typical drinking behavior and 21st birthday drinking behavior among college students: Implications for event-specific prevention. Addiction 2009;104:760–767. [PubMed: 19344447]

Mallett KA, Lee CM, Neighbors C, Larimer ME, Turrisi R. Do we learn from our mistakes? An examination of the impact of negative alcohol related consequences on college student drinking patterns and perceptions. Journal of Studies on Alcohol 2006;67:269–276. [PubMed: 16562409]

Martin M, Hofer SM. Intraindividual variability, change, and aging: Conceptual and analytical issues. Gerontology 2004;50:7–11. [PubMed: 14654720]

Molenaar PCM. A manifesto on psychology as idiographic science: Bringing the person pack into scientific psychology, this time forever. Measurement 2004;2:201–218.

Muthén BO, Muthén LK. Integrating person-centered and variable-centered analyses: Growth mixture modeling with latent trajectory classes. Alcoholism: Clinical and Experimental Research 2000a; 24:882–891.

Muthén BO, Muthén LK. The development of heavy drinking and alcohol-related problems from ages 18 to 37 in a U. S. national sample. Journal of Studies on Alcohol 2000b;61:290–300.

Neal DJ, Carey KB. Association between alcohol intoxication and alcohol-related problems: An event-level analysis. Psychology of Addictive Behaviors 2007;21:194–204. [PubMed: 17563139]

Neal DJ, Fromme K. Event-level covariation of alcohol intoxication and behavioral risks during the first year of college. Journal of Consulting and Clinical Psychology 2007;75:294–306. [PubMed: 17469887]

Nesselroade, JR. The warp and the woof of the developmental fabric. In: Downs, RM.; Liben, LS., editors. Visions of aesthetics, the environment and development: The legacy of Joachim F. Wohlwill. Hillsdale: Lawrence Erlbaum; 1991. p. 213-240.

Nesselroade JR. Intraindividual variability and short-term change. Gerontology 2004;50:44–47. [PubMed: 14654727]

Perkins HW. Surveying the damage: A review of research on consequences of alcohol misuse in college populations. Journal of Studies on Alcohol 2002 Supplement No. 14:91–100. [PubMed: 11925064]

Raudenbush, SW.; Bryk, AS. Hierarchical linear models: Applications and data analysis methods. 2nd Ed.. Thousand Oaks, CA: Sage Publications; 2002.

Redman S, Sanson-Fisher RW, Wilkinson C, Fahey PP, Gibberd RW. Agreement between two measures of alcohol consumption. Journal of Studies on Alcohol 1987;48:104–108. [PubMed: 3560945]

Rehm J, Greenfield TK, Rogers JD. Average volume of alcohol consumption, patterns of drinking, and all-cause mortality: Results from the US National Alcohol Survey. American Journal of Epidemiology 1996;153:64–71. [PubMed: 11159148]

Schmidt WC. World-Wide Web survey research: Benefits, potential problems, and solutions. Behavior Research Methods, Instruments, and Computers 1997;29:274–279.

Schuckit MA, Tipp JE, Smith TL, Wiesbeck GA, Kalmijn J. The relationship between self-rating of the effects of alcohol and alcohol challenge results in ninety-eight young men. Journal of Studies on Alcohol 1997;58:397–404. [PubMed: 9203121]

Schulenberg J, O'Malley PM, Bachman JB, Wadsworth KN, Johnston L. Getting drunk and growing up: Trajectories of frequent binge drinking during the transition to young adulthood. Journal of Studies on Alcohol 1996;57:289–304. [PubMed: 8709588]

Searles JS, Perrine MW, Mundt JC, Helzer JE. Self-report of drinking using touch-tone telephone: Extending the limits of reliable daily contact. Journal of Studies on Alcohol 1995;56:375–382. [PubMed: 7674671]

Smith MA, Leigh B. Virtual subjects: Using the internet as an alternative source of subjects and research environment. Behavior Research Methods, Instruments, and Computers 1997;29:496–505.

Sobell, LC.; Sobell, MB. Timeline followback: A technique for assessing self-reported alcohol consumption. In: Litten, RZ.; Allen, JP., editors. Measuring alcohol consumption: Psychosocial biochemical methods. Totowa, NJ: Humana Press; 1992.

Tennen H, Affleck G, Armeli S, Carney MA. A daily process approach to coping: Linking theory, research, and practice. American Psychologist 2000;55:626–636. [PubMed: 10892205]

Webb GR, Redman S, Sanson-Fisher RW, Gibberd RW. Comparison of a quantity-frequency method and a diary method of measuring alcohol consumption. Journal of Studies on Alcohol 1990;51:271–277. [PubMed: 2342367]

Wennberg P, Bohman M. The timeline follow back technique: Psychometric properties of a 28-day timeline for measuring alcohol consumption. German Journal of Psychiatry 1998;2:62–68.

Werch CE. Two procedures to reduce response bias in reports of alcohol consumption. Journal of Studies on Alcohol 1990;51:327–330. [PubMed: 2359305]

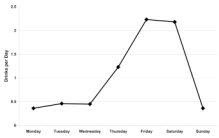

Figure 1.
Mean Drinks of Alcohol Consumed by Day of Week

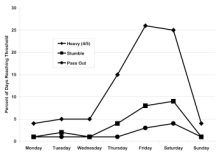

Figure 2.
Percent of Days Reaching Heavy Drinking Thresholds by Day of Weeks

Table 1

Multi-level Models Predicting Drinks Consumed on Weekdays and Weekends

Fixed Effects	Drinks per Day (Standard Errors)[a]
Predicting Weekday Drinking, β_{0i}	
Intercept[b], γ_{00}	$.332^{***}$ (.085)
Male Gender, γ_{01}	$.252^{**}$ (.092)
Early Drinker, γ_{02}	$.259^{***}$ (.075)
Non-Greeks (vs. Joiners), γ_{03}	$-.293^{**}$ (.095)
Intended Greeks (vs. Joiners), γ_{04}	−.105 (.125)
Fun-Social Motivations (centered), γ_{05}	.075 (.049)
Phys-Behavioural Motivations (centered), γ_{06}	$-.203^{**}$ (.065)
Predicting Weekend Slope, β_{1i}	
Intercept, γ_{10}	1.427^{***} (.156)
Male Gender, γ_{11}	$.625^{***}$ (.185)
Early Drinker, γ_{12}	$.560^{***}$ (.156)
Non-Greeks (vs. Joiners), γ_{13}	$-.884^{***}$ (.192)
Intended Greeks (vs. Joiners), γ_{14}	$-.446^{*}$ (.221)
Fun-Social Motivations, γ_{15}	$.551^{***}$ (.100)
Phys-Behavioural Motivations, γ_{16}	−.133 (.107)

$^{*}p < .05$.

$^{**}p < .01$.

$^{***}p < .001$

Note. Level 1 equations for full model: Drinks per Day$_{ti}$ = β_{0i} + β_{1i} (Weekend Day)+ r_{ti}; Level 2 equations: β_{0i} = $\gamma 00$ + $\gamma 01$ (Male Gender) + $\gamma 02$ (Early Drinker) + $\gamma 03$ (Non-Greek) + $\gamma 04$ (Intended Greeks) + $\gamma 05$ (Fun-Social Motivations) + $\gamma 06$ (Physical-Behavioural Motivations) + u_{0i}; β_{1i} = $\gamma 10$ + $\gamma 11$ (Male Gender) + $\gamma 12$ (Early Drinker) + $\gamma 13$ (Non-Greek) + $\gamma 14$ (Intended Greek) + $\gamma 15$ (Fun-Social Motivations) + $\gamma 16$ (Physical-Behavioural Motivations) + u_{1i}. Based on coding of Level 2 predictors, the reference group represents women who initiated alcohol use in Grade 10 or later and were members of Greek clubs with average fun-social and physical-behavioural motivations.

Table 2

Multi-Level Models Predicting Likelihood of Heavy Alcohol Use on Weekdays and Weekends.

Fixed Effects	Heavy Drinking OR (CI)	Stumble Days OR (CI)	Pass Out Days OR (CI)
Predicting Weekday Drinking, β_{0i}			
Intercept, γ_{00}	.02 (.01–.03)***	.009 (.005–.016)***	.004 (.002–.008)***
Male Gender, γ_{01}	.87 (.52–1.43)	.69 (.35–1.33)	.76 (.30–1.93)
Early Drinker, γ_{02}	2.35 (1.48–3.72)***	1.80 (1.00–3.23)*	1.69 (.74–3.87)
Non-Greeks (vs. Joiners), γ_{03}	.27 (.15–.48)***	.42 (.20–.88)*	.55 (.21–1.46)
Intended Greeks (vs. Joiners), γ_{04}	.79 (.46–1.36)	.86 (.43–1.72)	.67 (.25–1.76)
Fun-Social Motivations, γ_{05}	1.69(1.30–2.19)***	1.12 (.79–1.58)	.66 (.41–1.05)
Phys-Behav Motivations, γ_{06}	.54(.40–.74)***	.50 (.34–.74)***	.38 (.22–.66)***
Predicting Weekend Drinking Increment, β_{1i}			
Intercept[c], γ_{10}	7.59 (5.42–10.64)***	6.26 (3.83–10.23)***	4.09 (1.78–9.41)***
Male Gender, γ_{11}	1.32(.93–1.87)	1.06 (.60–1.85)	.71 (.28–1.78)
Early Drinker, γ_{12}	1.11 (.80–1.54)	1.00 (.61–1.63)	1.13 (.50–2.57)
Non-Greeks (vs. Joiners), γ_{13}	1.11 (.74–1.68)	.88 (.47–1.64)	1.02 (.39–2.69)
Intended Greeks (vs. Joiners), γ_{14}	.84 (.59–1.20)	.67 (.39–1.17)	1.24 (.50–3.08)
Fun-Social Motivations, γ_{15}	1.25(1.04–1.49)*	1.15 (.86–1.53)	1.69 (1.09–2.62)*
Phys-Behav Motivations, γ_{16}	1.29(1.04–1.60)*	1.11 (.79–1.55)	1.15 (.66–2.01)

* $p<.05$.

** $p<.01$.

*** $p<.001$.

Note. A Bernoulli distribution was assumed for these dichotomous outcomes, with the following equations: Level 1: $\text{Prob}(Y_{ti}=1|\beta)=\pi$. $\log[\pi/(1-\pi)]=\beta_{0i}$. Level 2: $\beta_{0i}=\gamma_{00}+u_{0i}$. Based on coding of Level 2 predictors, the reference group represents women who initiated alcohol use in Grade 10 or later and were members of Greek clubs with average fun-social and physical-behavioural motivations.