Age-Related Changes in Associations Between Reasons for Alcohol Use and High-Intensity Drinking Across Young Adulthood

MEGAN E. PATRICK, PH.D.,^{a,*} REBECCA EVANS-POLCE, PH.D.,^a DEBORAH D. KLOSKA, M.A.,^a
JENNIFER L. MAGGS, PH.D.,^a & STEPHANIE T. LANZA, PH.D.^a

^a*Institute for Social Research, University of Michigan, Ann Arbor, Michigan*

ABSTRACT. Objective: Analyses focus on whether self-reported reasons for drinking alcohol change in their associations with high-intensity drinking across the transition to adulthood. **Method:** Self-report data on high-intensity drinking (10+ drinks) collected from the national Monitoring the Future study in 2005 to 2014 from those ages 18–26 were used ($N = 2,664$ [60% women] for all drinkers and 1,377 for heavy episodic [5+] drinkers; up to 6,541 person-waves). Time-varying effect modeling examined changes in the direction and magnitude of associations between eight reasons for drinking and high-intensity alcohol use across continuous age. **Results:** Four reasons to drink showed quite stable associations with high-intensity drinking across age: drinking to get away from problems, to get high, to relax, and to sleep. Associations between two reasons and high-intensity drinking decreased with

age: anger/frustration and to have a good time. The association between drinking because of boredom and high-intensity drinking increased with age. Drinking because it tastes good had a weak association with high-intensity drinking. Among heavy episodic drinkers, reasons for use also differentiated high-intensity drinking, with two exceptions: drinking to have a good time and to relax did not distinguish drinking 10+ drinks from drinking 5–9 drinks. **Conclusions:** Reasons for drinking are differentially associated with high-intensity drinking, compared with any other drinking and compared with lower intensity heavy drinking, across age during the transition to adulthood. Intervention programs seeking to mitigate alcohol-related harms should focus on reasons for use when they are the most developmentally salient. (*J. Stud. Alcohol Drugs*, 78, 558–570, 2017)

NUMEROUS THEORETICAL MODELS of substance use posit that individuals' subjective reasons and motivations for alcohol use are proximal explanations of behavior through which other more distal causes exert influence (e.g., Cooper et al., 1995; Cox & Klinger, 1988). Reasons or motives for drinking are "a subjectively derived decisional framework for alcohol use based on personal experience, situation and expectancies" (Kuntsche et al., 2005). Empirically, adolescents' and young adults' self-reported reasons and motivations for drinking are powerful between-person predictors of alcohol use and heavy drinking concurrently (e.g., Johnston & O'Malley, 1986) and longitudinally (e.g., Cooper et al., 2008; Patrick & Schulenberg, 2011; White et al., 2016). They also predict problematic drinking prospectively over short time frames (e.g., heavy weekend drinking, 2 weeks; Kuntsche & Cooper, 2010) and long time frames (e.g., symptoms of alcohol use disorder, 17 years; Patrick et al., 2011a). The present article focuses on whether associations between self-reported reasons for drinking and high-intensity alcohol use change across the transition to adulthood.

Life span developmental approaches see behaviors embedded within multiple, linked levels of influence from childhood through adulthood (Bronfenbrenner & Morris, 1998; Elder, 1998). Development, in normative terms, encompasses commonly—but not universally—experienced patterns of change in multiple domains, each affecting the other (Schulenberg & Maggs, 2002). In Western societies, the prevalence of heavy drinking behaviors peaks, on average, roughly in the early 20s (Chassin et al., 2002; Johnston et al., 2016; Patrick & Schulenberg, 2011). Multiple underlying sources of influence for this behavioral pattern have been proposed (Brown et al., 2008; Schulenberg & Maggs, 2002), including neurodevelopmental changes (Steinberg, 2007), social role transitions (Bachman et al., 2002; Leonard & Homish, 2005; Maggs et al., 2012; Staff et al., 2010; Yamaguchi & Kandel, 1985), and personality development (Littlefield et al., 2009, 2010). Although these explanations suggest deeper etiological origins of developmental patterns in substance use, an alternative more proximal level of explanation lies in the subjective reasons that individual drinkers may ascribe to their behaviors. Unlike more distal explanations (e.g., neurobiological maturity or marital

Received: September 14, 2016. Revision: December 20, 2016.

This study was funded by support from the National Institute on Alcohol Abuse and Alcoholism (Grants R01AA023504 to Megan E. Patrick and R01AA002087 to Christine M. Lee for manuscript preparation) and the National Institute on Drug Abuse (Grants R01DA037902 to Megan E. Patrick, R01DA039854 to Stephanie T. Lanza, and P50DA039838 to Linda M. Collins for manuscript preparation; and R01DA001411 and R01DA016575 to Lloyd

D. Johnston for data collection and manuscript preparation). The content here is solely the responsibility of the authors and does not necessarily represent the official views of the sponsors.

*Correspondence may be sent to Megan E. Patrick at the Institute for Social Research, University of Michigan, 426 Thompson St., Ann Arbor, MI, 48106-1248, or via email at: meganpat@umich.edu.

status), self-reported reasons may be particularly amenable to amelioration through prevention efforts (Coffman et al., 2007; Newcomb et al., 1988; White et al., 2016).

A series of recent articles has begun to examine developmental changes in reasons for drinking across the transition to adulthood. Analyses of nationally representative Monitoring the Future data, which longitudinally follow successive cohorts of U.S. high school seniors into adulthood, describe normative trends in self-reported reasons for drinking across ages 18–30. These analyses demonstrate that age 18 reasons predict alcohol use and heavy episodic drinking concurrently (Patrick et al., 2011b) and alcohol use disorders longitudinally at age 35 (Patrick et al., 2011a), and that latent trajectories of reasons covary with latent trajectories of heavy episodic drinking through age 30 (Patrick & Schulenberg, 2011). This work establishes that reasons are powerful proximal and longer term predictors of important indicators of alcohol use and that reasons change in developmentally predictable patterns that appear to underlie changes in drinking patterns across this crucial period. For example, across the transition to adulthood, drinking to relax, to get to sleep, and because it tastes good tend to increase, whereas drinking because of anger and frustration, because of boredom, or to get away from problems, get high, or have a good time with friends tend to decrease (Patrick & Schulenberg, 2011; Patrick et al., 2011b).

Although these studies provide key insights into links between reasons or motivations for alcohol use during the transition to adulthood, they also leave important questions unanswered that we address in the present analyses. First, most research on reasons and motivations has focused on predicting traditional indicators of alcohol use and heavy episodic drinking (e.g., 5+ drinks per occasion). However, recent calls have argued for greater focus on high-intensity drinking—defined as having 10 or more drinks in a row in the prior 2 weeks—which is both prevalent in this age range and highly dangerous (Hingson & White, 2013; Patrick, 2016; Patrick & Terry-McElrath, 2017; Patrick et al., 2013). High-intensity drinking peaks in the early 20s (Patrick et al., 2016), although little is known about the motivational context of this behavior. Among U.S. college students, those with greater social, enhancement, and coping motivations for alcohol use were shown to be more likely to consume at least 8 (women) or 10 (men) drinks on a single occasion in the prior month; motivations also predicted alcohol quantity, frequency, and problems, as well as increases in high-intensity drinking 6 months later (White et al., 2016). In this article, we extend this prior work by examining whether associations between reasons for drinking and high-intensity drinking vary across the transition to adulthood among a broader group of young adults.

Second, although normative developmental changes in alcohol use are well understood (e.g., Brown et al., 2008; Schulenberg & Maggs, 2002) and recent work has begun

to document normative changes with age in reasons for use (Patrick et al., 2011b), it is less clear how the association of reasons with alcohol use also changes with age beyond high school. Major explanations for changes in alcohol use prevalence—neurological development (e.g., Spear & Varlinskaya, 2010), increased maturity (e.g., Andersson & Magnusson, 1990), normative developmental changes (Schulenberg & Maggs, 2002), and changes in social roles (e.g., Leonard & Rothbard, 1999)—may also suggest that the underlying functions of alcohol use change. In addition, greater lifetime experience with alcohol use and heavy drinking, along with the associated consequences, may lead to shifts in alcohol-specific knowledge, skills, and goals. It is possible but not inevitable that the predictive power of particular reasons parallels normative changes in their prevalence. For example, endorsement of “to relax” as a reason for drinking increases across the 20s (Patrick et al., 2011b). The size and direction of the link between individual differences in drinking to relax and heavy drinking, however, may increase (with learned experience that drinking facilitates relaxation), decrease (as this reason becomes more normative across all people), or remain unchanged.

Previous work in this area using latent growth curve modeling has shown that the normative increase in heavy episodic drinking occurring from ages 18 to 22 is most strongly correlated with an increase in drinking to get high and because of boredom, whereas continued heavy episodic drinking from ages 22 to 30 is strongly correlated with the slope of drinking to get away from problems (Patrick & Schulenberg, 2011). This informs our understanding of how reasons and drinking may change together across development. We compare high-intensity (10+) drinkers to all other drinkers (1–9 drinks) and to lower intensity heavy episodic drinkers (5–9 drinks), and we examine how the link between reasons for use and drinking at a given age changes across young adulthood. We aim to provide insight regarding specific ages when certain reasons are particularly strong risk factors for high-intensity drinking.

Current study

High-intensity drinking is an important health behavior, and understanding how reasons for drinking are associated with this level of alcohol use is key for informing interventions. Furthermore, associations between reasons for drinking and high-intensity drinking may change normatively across the transition to adulthood, making some reasons particularly crucial correlates and potential intervention targets in certain age ranges. The current study is the first to examine how reasons for drinking are associated with high-intensity alcohol use, compared with all other drinking and compared with lower intensity heavy episodic drinking, across age during the transition to adulthood. We do so using longitudinal data following a nationally representa-

tive sample of high school seniors through their mid-20s. Specifically, Aim 1 is to examine age-related associations between reasons for alcohol use and high-intensity drinking among all drinkers, and Aim 2 is to examine age-related associations between reasons for alcohol use and high-intensity drinking among lower intensity heavy episodic drinkers. Both aims examine associations as time-varying from ages 18 to 26, after controlling for sex, race/ethnicity, parental education, and college attendance.

Method

Sample

This study uses longitudinal data from Monitoring the Future (MTF), an ongoing study of adolescents and young adults, annually surveying nationally representative samples of about 16,000 high school seniors (modal age 18) in their classrooms (Johnston et al., 2015). Approximately 2,400 individuals are selected from each senior year cohort for biennial follow-up via mailed questionnaires, beginning 1 year after high school completion for one random half and 2 years after high school for the other half (Johnston et al., 2015).

This study focused on MTF data collected at modal ages 19/20, 21/22, 23/24, and 25/26 across years 2005 (when a high-intensity drinking measure was first included) to 2014. Reasons for alcohol use that were sufficiently prevalent ($\geq 10\%$ at any age) were examined. Those respondents ages 18–26 who provided data on all variables of interest at baseline (age 18) and for at least one follow-up survey were included in this Aim 1 analysis ($N = 2,664$; 6,541 person-waves); associations after age 26 were not modeled due to sparser data resulting from lower prevalence of high-intensity drinking in the later 20s. Aim 2 analyses were further restricted to past-2-week 5+ drinkers ($n = 1,377$; 2,453 person-waves). Compared with those who provided at least one follow-up wave of data, those who were selected for follow-up but provided only age 18 data were more likely to be male; be White; have parents with a high school education or less; and report 30-day use of cigarettes, alcohol, and marijuana. The analytic sample was 60% female, 74% White, 6.5% African American, 9.5% Hispanic, and 10% Asian and other races; 51% of the sample reported having one or both parents with at least some college education. Age in years was based on the sample modal age at each data collection point, resulting in coverage of every age from 18 to 26.

Measures

Heavy episodic and high-intensity drinking. At each assessment, individuals who reported any alcohol use in the past 12 months were asked, “During the past two weeks, how

many times have you had 5 or more [10 or more] drinks in a row?” We coded heavy episodic drinkers as anyone who reported one or more times of 5+ drinks and high-intensity drinkers as anyone who reported one or more times of 10+ drinks.

Reasons for alcohol use. At each assessment, individuals who reported any alcohol use in the past 12 months were asked, “What have been the most important reasons for your drinking alcoholic beverages?” The present analyses focus on the 8 (of 14) most prevalent reasons for drinking that were reported by at least 10% of the drinkers at any age: (1) because of anger or frustration (*anger*), (2) because of boredom (*bored*), (3) to get away from problems or troubles (*get away*), (4) to feel good or get high (*get high*), (5) to have a good time with my friends (*good time*), (6) to relax or relieve tension (*relax*), (7) to get to sleep (*sleep*), and (8) because it tastes good (*taste*). This measure has been included in the study since 1976, thus predating current multidimensional drinking motives scales; however, several items are consistent with Coping (anger, get away, relax), Social (good time), and Enhancement (bored, get high) reasons for drinking (as in Cooper, 1994).

Covariates. We controlled for a number of potential confounders including sex (*male* = 1, *female* = 0), race/ethnicity (White [reference], Black, Hispanic, and other races), and parental education (*mother or father has at least some college* = 1, 0 otherwise), which were measured at baseline, and college status (*currently attending a 4-year college full time at modal ages 19/20* = 1, 0 if not).

Analysis

Analyses were conducted using time-varying effect modeling (TVEM), which estimates regression coefficients across continuous time (e.g., age) in a nonparametric way (Li et al., 2015). TVEM has an advantage over standard regression-based methods in that it allows considerable flexibility to examine changes in the direction and magnitude of associations between alcohol reasons and high-intensity drinking by estimating each regression coefficient as a nonparametric function of age. Using logistic TVEM, we estimated the log-odds of high-intensity drinking from ages 18 to 26. We converted the log-odds to prevalence estimates to facilitate interpretation of the age trends in high-intensity drinking. Similarly, we estimated a separate model predicting the log-odds of reporting each of the eight reasons for alcohol use across these ages to examine how the prevalence of these reasons changes across young adulthood.

To examine the age-varying associations between reasons for alcohol use and high-intensity drinking, we first fit an unadjusted logistic TVEM model, separately for each of the eight reasons for alcohol use. Then, we examined these age-varying associations of reasons for drinking and high-intensity drinking, controlling for sex, race/ethnicity, parental

education, and college status. Each of these variables' associations with high-intensity drinking was allowed to vary across age. The equation below was specified to model the association between each alcohol reason and high-intensity drinking:

$$\ln \left(\frac{P(\text{Drink}_{it} = 1)}{1 - P(\text{Drink}_{it} = 1)} \right) = \beta_0(t) + \beta_1(t) \text{Alcohol Reason}_{it} \\ + \beta_2(t) \text{Male}_i + \beta_3(t) \text{Black}_i + \beta_4(t) \text{Hispanic}_i \\ + \beta_5(t) \text{Other}_i + \beta_6(t) \text{ParentEd}_i + \beta_7(t) \text{College}_i$$

where i refers to the individual and t to the age of an individual at a particular assessment. Note that each regression coefficient is specified to be age varying (i.e., estimated as a continuous function of t).

For Aim 1, analyses included all past-year alcohol users to compare high-intensity drinkers with all other past-year drinkers. For Aim 2, we restricted the analytic sample to 5+ drinkers to compare high-intensity (10+ drinks) drinkers with lower intensity (5–9 drinks) heavy episodic drinkers.

All analyses were conducted using SAS 9.4 (SAS Institute Inc., Cary, NC) and the %TVEM macro (Li et al., 2015; Methodology Center, 2015). P-spline smoothing was used for all models; this approach automatically selects the optimal form of each coefficient function based on information criteria that balance the tradeoff between model fit and parsimony. TVEM results are presented as figures because the coefficients are estimated as functions of age, making the number of coefficients across age too large to present in tables. Solid lines represent odds ratio (OR) estimates and dashed lines 95% confidence intervals (CI). TVEM estimates splines using data from nearby ages; therefore, estimates at both the beginning and the end of the age period tend to have wider confidence intervals due to less information at these ages.

Comparison with other approaches

The TVEM approach has unique contributions compared with other approaches, such as latent growth curve modeling (LGCM; e.g., as used in Patrick & Schulenberg, 2011). First, LGCM requires specification of a parametric form (e.g., linear, quadratic), and any inflection points must be specified by the analyst. TVEM is nonparametric; multiple inflection points are empirically determined for each construct separately. Thus, nuance in age-related changes, which may be obscured using LGCM, can be revealed. Second, in LGCM the association between the constructs (e.g., reasons for drinking and alcohol use) is typically modeled as the correlations between the intercepts and the slopes. That is, the model tests whether linear change in reasons for use is associated with linear change in alcohol use. However, TVEM models the cross-sectional correlations (e.g., between reasons for drinking and alcohol use) at each age, showing

FIGURE 1. Prevalence of high-intensity drinking, across age, among all past-year drinkers

how these age-specific links between constructs vary with age.

Results

Prevalence of high-intensity drinking and reasons for alcohol use across age among all drinkers

The percentage of past-year alcohol users who reported high-intensity drinking was quite stable across young adulthood (Figure 1), ranging from 14% to 17% across this age period, although consistency by age varied by reason (Figure 2). Drinking because of anger did not vary substantially, ranging 11%–14% across ages 18–26 (Figure 2a). Endorsement of drinking because of boredom (Figure 2b) and to get away from problems (Figure 2c) decreased steadily, from 24% at age 18 to 11% and 16% for boredom and to get away from problems, respectively, at age 26. Drinking to feel good or to get high peaked at 42% around age 20, decreasing slightly by age 26 (Figure 2d). Drinking to have a good time was endorsed by close to 80% across all ages (Figure 2e). Drinking to relax was endorsed by 45% at age 18 and increased steeply to 75% at age 26 (Figure 2f). Drinking to get to sleep was endorsed by 6%–10% across all ages (Figure 2g). Drinking because it tastes good was endorsed by about 40% at age 18, with the rate increasing to 62% at age 26 (Figure 2h).

Adjusted age-varying associations between reasons for using alcohol and high-intensity drinking among all drinkers (Aim 1)

All reasons for drinking had a significant positive association ($OR > 1.0$) with engaging in high-intensity drinking through at least age 25 (Figure 3). However, the degree to which the association changed across ages 18–26 varied by

FIGURE 2. Self-reported prevalence of using alcohol for each of eight reasons, across age, among all past-year drinkers

reason. Four reasons to drink showed quite stable associations with high-intensity drinking across age: drinking to get away from problems (OR of about 2.5 across age; Figure 3c), to feel good or get high (OR between 3 and 4 across age; Figure 3d), to relax or relieve tension (OR of about 2 with a slight increase at older ages, suggesting that importance may increase into adulthood; Figure 3f), and to get to sleep (OR of about 2.5 across age; Figure 3g).

Associations between two reasons and high-intensity drinking decreased with age. High school seniors who reported drinking because of anger or frustration (Figure 3a) had 3.8 times (95% CI [2.5, 5.9]) greater odds of engaging in high-intensity drinking compared with seniors not reporting that reason; by age 25 this association weakened

by half (OR = 1.9, 95% CI [1.0, 3.5]). Drinking to have a good time also had stronger associations with engaging in high-intensity drinking at younger ages with an OR above 4.0 at age 18, which weakened to nonsignificance by age 26 (Figure 3e).

The association between drinking because of boredom and high-intensity drinking increased with age (Figure 3b). This association was weakest at age 18 (OR = 1.9, 95% CI [1.3, 2.7]) and more than doubled by age 21 (OR = 4.7, 95% CI [3.7, 6.1]). Thereafter, the association remained steady with age. Drinking because it tastes good had one of the weakest associations with engaging in high-intensity drinking, with the OR peaking at age 19 at 2.0, 95% CI [1.6, 2.6]. This link weakened slightly with age, such that by age 23

FIGURE 2. Continued

it was no longer significantly associated (Figure 3h). These analyses controlled for age-varying effects of sex, parental education, race/ethnicity, and 4-year college attendance at age 19/20; bivariate results for controls are shown in Appendix A.

Prevalence of high-intensity drinking and reasons for alcohol use across age among heavy drinkers

In analyses designed to distinguish high-intensity from other heavy drinkers, the prevalence of high-intensity drinking had an earlier (age 18) and higher (48.0%) peak among heavy episodic (5+) drinkers compared with the full sample of all drinkers and declined through age 26 to 37.5% (Figure 4). Comparing Figures 1 and 4, prevalence of all reasons

was higher among heavy episodic drinkers than among all drinkers. However, patterns across age were very similar (Figure 5). Of note, drinking to have a good time had the highest prevalence of all the reasons across young adulthood (89%–97% among heavy drinkers).

Adjusted age-varying associations between reasons for using alcohol and high-intensity drinking among heavy episodic drinkers (Aim 2)

Among heavy episodic drinkers only, reasons were associated with increased odds of high-intensity drinking compared with lower intensity heavy drinking (Figure 6). Similar age-varying patterns were observed in results described above among all drinkers, with two exceptions: Drinking to

FIGURE 3. Age-varying associations between eight reasons to use alcohol and the odds of high-intensity drinking across age, among all past-year drinkers, adjusted for covariates. Note: Covariates with time-varying effects included in the models were sex, race/ethnicity, parental education, and college status at age 19/20.

have a good time (Figure 6e) and to relax (Figure 6f) did not distinguish high-intensity (10+ drinks) from lower intensity (5–9 drinks) heavy drinking at any age. These analyses controlled for age-varying effects of sex, parental education, race/ethnicity, and 4-year college attendance at age 19/20; bivariate results for controls are shown in Appendix B.

Discussion

Identifying reasons for drinking is important to understanding high-intensity drinking and how to mitigate its consequences. Research has shown that motives or reasons for drinking are predictors of alcohol-related behaviors

(Anderson et al., 2013; Carey & Correia, 1997; Merrill et al., 2014; Patrick et al., 2011a; White et al., 2016). This is the first study to document how the links between drinking motives and high-intensity drinking vary by age across the transition to adulthood. Reasons for drinking indeed showed variation in associations across age, suggesting that high-intensity drinking may be the result of different types of motives for use at different phases of development, even during this relatively short span of 8 years. During the first few years after high school, drinking because of anger or frustration and to have a good time are particularly strong reasons for use among high-intensity drinkers, compared with the mid-20s. Interventions focusing on high school or

FIGURE 3. *Continued*

early college students may be particularly effective when these reasons for use are acknowledged, and targeted interventions incorporating these particular reasons for use may also be warranted (Coffman et al., 2007).

On the other hand, by the mid-20s, drinking because of boredom declines in prevalence but remains a stronger correlate of high-intensity drinking. Thus, young adults who continue feeling bored beyond the developmentally normative experience of boredom in adolescence (Biolcati et al., 2016; Larson & Richards, 1991; Martz et al., 2016) may be at elevated risk for high-intensity drinking. Young adults who engage in high-intensity drinking because of boredom may require intervention strategies that, for example, help them become involved in alternative engaging and meaningful activities (e.g., Caldwell et al., 2004).

FIGURE 4. Prevalence of high-intensity drinking, across age, among heavy episodic drinkers

FIGURE 5. Self-reported prevalence of using alcohol for each of eight reasons, across age, among heavy episodic drinkers

All eight reasons for drinking had significant and positive associations with engaging in high-intensity drinking among past-year drinkers. Moreover, most reasons for drinking further distinguished high-intensity drinkers from lower intensity heavy drinkers. These results support arguments and early research that high-intensity drinking is distinct from heavy episodic drinking (Patrick, 2016; White et al., 2016). The exceptions were that drinking to have a good time and to relax did not distinguish high-intensity drinking among heavy drinkers, likely because these reasons were endorsed by most to nearly all heavy drinking young adults. Reasons strongly associated with high-intensity drinking across ages 18–26 included drinking because of anger or frustration and to get high. Drinking to get away from problems was a

moderately strong predictor across age. Previous research has shown that drinking to cope (e.g., to get away, because of anger or frustration) is associated with alcohol-related problems, and drinking for enhancement reasons (e.g., to get high) is associated with heavy episodic drinking (Cooper et al., 1995; Cox & Klinger, 1988; Kuntsche et al., 2005).

Similarly, White et al. (2016) found that college student women/men who consumed 8+/10+ drinks on single occasions had higher social, enhancement, and coping motives. High-intensity drinking may require new intervention approaches, given that the majority of prevention and intervention programs tested to date have relied on measures defining heavy drinking more generally as 4+/5+ or 5+ drinks on one occasion (Pearson et al., 2016). The present results suggest

FIGURE 5. *Continued*

that interventions (e.g., motivational interviewing, personalized feedback interventions) that target high-intensity drinking and related consequences should acknowledge rarer but important motives including anger or frustration, a desire to get high, and escaping problems. At the same time, it is important to document why common reasons (e.g., to have a good time) may not help explain high-intensity drinking compared with lower intensity heavy episodic drinking.

Limitations and conclusions

Limitations of this work include that reasons for use were asked among past-year alcohol users with dichotomous check-all-that-apply items rather than a validated set of subscales assessing motivations. Also, high school dropouts

were not included in the sample. Strengths include the national study across the transition to adulthood with repeated measures of reasons for use and high-intensity drinking and the innovative statistical method to elucidate age-varying associations. These findings are the first to demonstrate that associations between reasons for alcohol use and high-intensity drinking behavior change across age, with particular reasons gaining and losing salience across development and experience. Furthermore, reasons for drinking can help distinguish high-intensity drinkers from lower intensity heavy drinkers, which supports tailoring of interventions for those at greatest risk. Future research should examine patterns of reasons for use within individuals across age, and how changes in motives across time are associated with alcohol use disorders and other adult outcomes.

FIGURE 6. Age-varying associations between eight reasons to use alcohol and the odds of high-intensity drinking across age, among heavy episodic drinkers, adjusted for covariates. Note: Covariates with time-varying effects included in the models were sex, race/ethnicity, parental education, and college status at age 19/20.

Conflict of Interest Statement

The authors declare no conflict of interest.

References

- Anderson, K. G., Briggs, K. E., & White, H. R. (2013). Motives to drink or not to drink: Longitudinal relations among personality, motives, and alcohol use across adolescence and early adulthood. *Alcoholism: Clinical and Experimental Research*, 37, 860–867. doi:10.1111/acer.12030
- Andersson, T., & Magnusson, D. (1990). Biological maturation in adolescence and the development of drinking habits and alcohol abuse among young males: A prospective longitudinal study. *Journal of Youth and Adolescence*, 19, 33–41. doi:10.1007/BF01539443
- Bachman, J. G., O'Malley, P. M., Schulenberg, J. E., Johnston, L. D., Bryant, A. L., & Merline, A. C. (2002). *The decline of substance use in young adulthood: Changes in social activities, roles, and beliefs*. Mahwah, NJ: Lawrence Erlbaum Associates.
- Biolcati, R., Passini, S., & Mancini, G. (2016). I cannot stand the boredom. Binge drinking expectancies in adolescence. *Addictive Behaviors Reports*, 3, 70–76. doi:10.1016/j.abrep.2016.05.001
- Bronfenbrenner, U., & Morris, P. A. (1998). The ecology of developmental processes. In W. Damon & R. M. Lerner (Eds.), *Handbook of child psychology, Volume 1: Theoretical models of human development* (5th ed., Vol. 1, pp. 993–1028). Hoboken, NJ: John Wiley & Sons, Inc.
- Brown, S. A., McGue, M., Maggs, J., Schulenberg, J., Hingson, R., Swartzwelder, S., . . . Murphy, S. (2008). A developmental perspective on alcohol and youths 16 to 20 years of age. *Pediatrics*, 121, Supplement 4, S290–S310. doi:10.1542/peds.2007-2243D
- Caldwell, L., Smith, E., Wegner, L., Vergnani, T., Mpofu, E., Flisher, A. J., & Mathews, C. (2004). Health wise South Africa: Development of a life skills curriculum for young adults. *World Leisure Journal*, 46, 4–17. doi:10.1080/04419057.2004.9674362

FIGURE 6. Continued

- Carey, K. B., & Correia, C. J. (1997). Drinking motives predict alcohol-related problems in college students. *Journal of Studies on Alcohol*, 58, 100–105. doi:10.15288/jsa.1997.58.100
- Chassin, L., Pitts, S. C., & Prost, J. (2002). Binge drinking trajectories from adolescence to emerging adulthood in a high-risk sample: Predictors and substance abuse outcomes. *Journal of Consulting and Clinical Psychology*, 70, 67–78. doi:10.1037/0022-006X.70.1.67
- Coffman, D. L., Patrick, M. E., Palen, L. A., Rhoades, B. L., & Ventura, A. K. (2007). Why do high school seniors drink? Implications for a targeted approach to intervention. *Prevention Science*, 8, 241–248. doi:10.1007/s11121-007-0078-1
- Cooper, M. L. (1994). Motivations for alcohol use among adolescents: Development and validation of a four-factor model. *Psychological Assessment*, 6, 117–128. doi:10.1037/1040-3590.6.2.117
- Cooper, M. L., Frone, M. R., Russell, M., & Mudar, P. (1995). Drinking to regulate positive and negative emotions: A motivational model of alcohol use. *Journal of Personality and Social Psychology*, 69, 990–1005. doi:10.1037/0022-3514.69.5.990
- Cooper, M. L., Krull, J. L., Agocha, V. B., Flanagan, M. E., Orcutt, H. K., Grabe, S., . . . Jackson, M. (2008). Motivational pathways to alcohol use and abuse among Black and White adolescents. *Journal of Abnormal Psychology*, 117, 485–501. doi:10.1037/a0012592
- Cox, W. M., & Klinger, E. (1988). A motivational model of alcohol use. *Journal of Abnormal Psychology*, 97, 168–180. doi:10.1037/0021-843X.97.2.168
- Elder, G. H., Jr. (1998). The life course as developmental theory. *Child Development*, 69, 1–12. doi:10.1111/j.1467-8624.1998.tb06128.x
- Hingson, R. W., & White, A. (2013). Trends in extreme binge drinking among US high school seniors. *JAMA Pediatrics*, 167, 996–998. doi:10.1001/jamapediatrics.2013.3083
- Johnston, L. D., & O'Malley, P. M. (1986). Why do the nations' students use drugs and alcohol? Self-reported reasons from nine national surveys. *Journal of Drug Issues*, 16, 29–66. doi:10.1177/002204268601600103
- Johnston, L. D., O'Malley, P. M., Bachman, J. G., Schulenberg, J. E., & Miech, R. A. (2015). *Monitoring the Future national survey results on drug use, 1975-2014: Volume II, College students and adults ages*

- 19-55. Ann Arbor, MI: Institute for Social Research, The University of Michigan.
- Johnston, L. D., O'Malley, P. M., Bachman, J. G., Schulenberg, J. E., & Miech, R. A. (2016). *Monitoring the Future national survey results on drug use, 1975-2015: Volume II, College students and adults ages 19-55*. Ann Arbor, MI: Institute for Social Research, The University of Michigan.
- Kuntsche, E., & Cooper, M. L. (2010). Drinking to have fun and to get drunk: Motives as predictors of weekend drinking over and above usual drinking habits. *Drug and Alcohol Dependence, 110*, 259-262. doi:10.1016/j.drugalcdep.2010.02.021
- Kuntsche, E., Knibbe, R., Gmel, G., & Engels, R. (2005). Why do young people drink? A review of drinking motives. *Clinical Psychology Review, 25*, 841-861. doi:10.1016/j.cpr.2005.06.002
- Larson, R. W., & Richards, M. H. (1991). Boredom in the middle school years - blaming schools versus blaming students. *American Journal of Education, 99*, 418-443. doi:10.1086/443992
- Leonard, K. E., & Homish, G. G. (2005). Changes in marijuana use over the transition into marriage. *Journal of Drug Issues, 35*, 409-429. doi:10.1177/002204260503500209
- Leonard, K. E., & Rothbard, J. C. (1999). Alcohol and the marriage effect. *Journal of Studies on Alcohol, Supplement 13*, 139-146. doi:10.15288/jsas.1999.s13.139
- Li, R., Dziak, J. D., Tan, X., Huang, L., Wagner, A. T., & Yang, J. (2015). TVEM (time-varying effect modeling) SAS macro users' guide (Version 3.1.0). University Park: The Methodology Center, Penn State. Retrieved from: <http://methodology.psu.edu>
- Littlefield, A. K., Sher, K. J., & Wood, P. K. (2009). Is maturing out of problematic alcohol involvement related to personality change? *Journal of Abnormal Psychology, 118*, 360-374. doi:10.1037/a0015125
- Littlefield, A. K., Sher, K. J., & Wood, P. K. (2010). Do changes in drinking motives mediate the relation between personality change and maturing out of problem drinking? *Journal of Abnormal Psychology, 119*, 93-105. doi:10.1037/a0017512
- Maggs, J. L., Jager, J., Patrick, M. E., & Schulenberg, J. (2012). Social role patterning in early adulthood in the USA: Adolescent predictors and concurrent wellbeing across four distinct configurations. *Longitudinal and Life Course Studies, 3*, 190-210. doi:10.14301/lcs.v3i2.183
- Martz, M. E., Schulenberg, J. E., Patrick, M. E., & Kloska, D. D. (2016). "I am so bored!" Prevalence rates and sociodemographic and contextual correlates of high boredom among American adolescents. *Youth & Society*. Advance online publication. doi:10.1177/0044118X15626624
- Merrill, J. E., Wardell, J. D., & Read, J. P. (2014). Drinking motives in the prospective prediction of unique alcohol-related consequences in college students. *Journal of Studies on Alcohol and Drugs, 75*, 93-102. doi:10.15288/jsad.2014.75.93
- Methodology Center. (2015). *TVEM SAS Macro* (Version 3.1.0). University Park: The Methodology Center, Penn State. Available at <http://methodology.psu.edu>
- Newcomb, M. D., Chou, C. P., Bentler, P. M., & Huba, G. J. (1988). Cognitive motivations for drug-use among adolescents - longitudinal tests of gender differences and predictors of change in drug-use. *Journal of Counseling Psychology, 35*, 426-438. doi:10.1037/0022-0167.35.4.426
- Patrick, M. E. (2016). A call for research on high-intensity alcohol use. *Alcoholism: Clinical and Experimental Research, 40*, 256-259. doi:10.1111/acer.12945
- Patrick, M. E., & Schulenberg, J. E. (2011). How trajectories of reasons for alcohol use relate to trajectories of binge drinking: National panel data spanning late adolescence to early adulthood. *Developmental Psychology, 47*, 311-317. doi:10.1037/a0021939
- Patrick, M. E., Schulenberg, J. E., Martz, M. E., Maggs, J. L., O'Malley, P. M., & Johnston, L. D. (2013). Extreme binge drinking among 12th-grade students in the United States: Prevalence and predictors. *JAMA Pediatrics, 167*, 1019-1025. doi:10.1001/jamapediatrics.2013.2392
- Patrick, M. E., Schulenberg, J. E., O'Malley, P. M., Johnston, L. D., & Bachman, J. G. (2011a). Adolescents' reported reasons for alcohol and marijuana use as predictors of substance use and problems in adulthood. *Journal of Studies on Alcohol and Drugs, 72*, 106-116. doi:10.15288/jsad.2011.72.106
- Patrick, M. E., Schulenberg, J. E., O'Malley, P. M., Maggs, J. L., Kloska, D. D., Johnston, L. D., & Bachman, J. G. (2011b). Age-related changes in reasons for using alcohol and marijuana from ages 18 to 30 in a national sample. *Psychology of Addictive Behaviors, 25*, 330-339. doi:10.1037/a0022445
- Patrick, M. E., & Terry-McElrath, Y. M. (2017). High-intensity drinking by underage young adults in the United States. *Addiction, 112*, 82-93. doi:10.1111/add.13556
- Patrick, M. E., Terry-McElrath, Y. M., Kloska, D. D., & Schulenberg, J. E. (2016). High-intensity drinking among young adults in the United States: Prevalence, frequency, and developmental change. *Alcoholism: Clinical and Experimental Research, 40*, 1905-1912. doi:10.1111/acer.13164
- Pearson, M. R., Kirouac, M., & Witkiewitz, K. (2016). Questioning the validity of the 4+/5+ binge or heavy drinking criterion in college and clinical populations. *Addiction, 111*, 1720-1726. doi:10.1111/add.13210
- Schulenberg, J. E., & Maggs, J. L. (2002). A developmental perspective on alcohol use and heavy drinking during adolescence and the transition to young adulthood. *Journal of Studies on Alcohol and Drugs, Supplement 14*, 54-70. doi:10.15288/jsas.2002.s14.54
- Spear, L. P., & Varlinskaya, E. I. (2010). Sensitivity to ethanol and other hedonic stimuli in an animal model of adolescence: Implications for prevention science? *Developmental Psychobiology, 52*, 236-243. doi:10.1002/dev.20457
- Staff, J., Schulenberg, J. E., Maslowsky, J., Bachman, J. G., O'Malley, P. M., Maggs, J. L., & Johnston, L. D. (2010). Substance use changes and social role transitions: Proximal developmental effects on ongoing trajectories from late adolescence through early adulthood. *Development and Psychopathology, 22*, 917-932. doi:10.1017/S0954579410000544
- Steinberg, L. (2007). Risk taking in adolescence - New perspectives from brain and behavioral science. *Current Directions in Psychological Science, 16*, 55-59. doi:10.1111/j.1467-8721.2007.00475.x
- White, H. R., Anderson, K. G., Ray, A. E., & Mun, E. Y. (2016). Do drinking motives distinguish extreme drinking college students from their peers? *Addictive Behaviors, 60*, 213-218. doi:10.1016/j.addbeh.2016.04.011
- Yamaguchi, K., & Kandel, D. B. (1985). Dynamic relationships between premarital cohabitation and illicit drug-use - an event-history analysis of role selection and role socialization. *American Sociological Review, 50*, 530-546. doi:10.2307/2095437