

## Accepted Manuscript

Solitary drinking is associated with specific alcohol problems in emerging adults

Matthew T. Keough, Roisin M. O'Connor, Sherry H. Stewart

PII: S0306-4603(17)30322-2  
DOI: doi: [10.1016/j.addbeh.2017.08.024](https://doi.org/10.1016/j.addbeh.2017.08.024)  
Reference: AB 5273  
To appear in: *Addictive Behaviors*  
Received date: 30 March 2017  
Revised date: 4 August 2017  
Accepted date: 28 August 2017



Please cite this article as: Matthew T. Keough, Roisin M. O'Connor, Sherry H. Stewart , Solitary drinking is associated with specific alcohol problems in emerging adults. The address for the corresponding author was captured as affiliation for all authors. Please check if appropriate. Ab(2017), doi: [10.1016/j.addbeh.2017.08.024](https://doi.org/10.1016/j.addbeh.2017.08.024)

This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

Solitary Drinking is Associated with Specific Alcohol Problems in Emerging Adults

Matthew T. Keough<sup>1</sup>, Ph.D., Roisin M. O'Connor<sup>2</sup>, Ph.D., and Sherry H. Stewart<sup>2</sup>, Ph.D.

<sup>1</sup>University of Manitoba, <sup>2</sup>Concordia University, <sup>3</sup>Dalhousie University

Author Note

Matthew T. Keough, University of Manitoba, Department of Psychology (190 Dysart Road, Winnipeg, Manitoba, Canada, R3T 2N2). Roisin M. O'Connor, Department of Psychology, Concordia University (7141 Sherbrooke St. West, Montreal, H4B 1R6, Quebec, Canada). Sherry H. Stewart, Department of Psychiatry and Department of Psychology and Neuroscience, Dalhousie University (6299 South St. Halifax, B3H 3J5, Nova Scotia, Canada).

This work was funded by a CIHR Operating Grant awarded to Roisin M. O'Connor. During completion of this project, Matthew T. Keough was supported by a Vanier Canada Graduate Scholarship from the Canadian Institutes of Health Research (CIHR), and Roisin M. O'Connor was supported in-part by a CIHR New Investigator Award. Sherry H. Stewart is supported by a Tier 1 CIHR Canada Research Chair in Addictions and Mental Health.

Correspondence concerning this article should be addressed to Matthew T. Keough, Email: matthew.keough@umanitoba.ca. Telephone: 204-474-7400.

## Abstract

Hazardous drinking in emerging adulthood is associated with multiple domains of alcohol problems, which range in type and severity. Alcohol problems at the severe end of the spectrum (e.g., impaired control) may be early warning signs of alcohol use disorders (AUDs) among emerging adults. However, given the emphasis in the literature on predictors of overall problem risk, we still know very little about predictors of these specific (and severe) domains of alcohol problems in emerging adults. Many emerging adults drink at social events (e.g., parties), but an estimated 15% engage in solitary drinking. Solitary drinking – a developmentally atypical behavior in emerging adulthood – may be especially risky. Data suggests that frequent solitary drinking may reflect a loss of control over drinking, leading to hazardous use and subsequent problems. Accordingly, we expected that frequent solitary drinking among emerging adults would predict severe alcohol problems that map onto diagnostic criteria for AUDs and these effects would be mediated by hazardous alcohol use. Undergraduates ( $N=118$ ) completed self-report measures as a part of a larger study on motivation and alcohol use. As predicted, path analysis showed that solitary drinking positively predicted hazardous alcohol use, and this in turn predicted severe alcohol problems associated with diagnostic criteria for AUDs, particularly risky behaviors and blackout drinking. Solitary drinking also positively predicted less severe problems of diminished self-perception and poor self-care through hazardous use. Though comparatively smaller, some indirect effects were observed from social drinking (at parties, but not at bars) to alcohol problems, via hazardous alcohol use. Overall, our results suggest that solitary drinking is particularly harmful in emerging adulthood.

**Keywords:** alcohol problems, emerging adults, university, solitary drinking

## 1. Introduction

Alcohol use peaks in emerging adulthood (e.g., during university studies) (Johnston, O'Malley, & Bachman, 1998). While heavy drinking predicts problems at any stage in life, research points to specific risks in undergraduates, which range in type and severity (Merrill, Wardell, & Read, 2014; Merrill & Read, 2010). To illustrate, a Canadian campus survey indicated that 53% of students report experiencing hangovers; 25% report memory loss or regret from intoxication; and nearly 20% report being physically and/or sexually harassed (Adlaf, Demers, & Gliksman, 2005). Alcohol problems at the severe end of the spectrum (e.g., impaired control, and dependence symptoms) may be early indicators of the development of alcohol use disorders (AUDs) (Nelson et al., 1996; Read et al., 2006). Research that examines the predictors of specific types of alcohol problems (especially those that are more severe) can inform early prevention and intervention efforts.

Much of the undergraduate drinking literature focuses on total number of alcohol problems (collapsing across multiple problem domains) (e.g., Kuntsche, Knibbe, Gmel, & Engels, 2005). While this work has been helpful for identifying predictors (e.g., personality traits [Pihl & Peterson, 1995]) of general elevated alcohol problems, there are issues with using a single total alcohol problems score. First, there can be substantial variability in associations across studies when using total alcohol problem scores. For example, conformity motives for drinking (i.e., drinking to “fit in”) are inconsistent predictors of total alcohol problems in undergraduates (Cooper, 1994; Magid, MacLean, & Colder, 2007; Merrill et al., 2014). However, when distinct alcohol problems domains are considered, conformity motives predict certain types of alcohol problems, and not others (Merrill & Read, 2010). Second, a total score may not accurately reflect risk severity. It is possible for two emerging adults to have the same overall score on a measure

of alcohol problems. However, when examined closely, one person may endorse problems within a few domains at the severe end of the spectrum (e.g., dependence symptoms), whereas the other person may report problems across several less severe domains. Based on prior work (e.g., Nelson et al., 1996) and clinical observation, it could be predicted that the individual experiencing the few severe problems (i.e., ones overlapping with diagnostic criteria for AUDs) may be at greatest risk. Accordingly, it is important to consider distinct types of alcohol problems as outcomes in etiological models of emerging adult drinking. This would allow us to examine risk factors that relate to specific (and severe) alcohol problems in emerging adulthood.

Social learning theory posits that drinking context is a relevant proximal predictor of alcohol problems among emerging adults. While many undergraduates drink at social events (e.g., campus parties) (Johnston et al., 1998), about 15% of students drink outside of normative social gatherings (Neff, 1997; O' Hare, 1990). Solitary drinking – a developmentally atypical behavior in emerging adulthood – is believed to be especially risky and potentially pathological (Keough, O'Connor, Sherry, & Stewart, 2015; Keough, Battista, O'Connor, Sherry, & Stewart, 2016). Emerging work shows that solitary (versus social) drinking is particularly associated with hazardous patterns of alcohol use (e.g., drinking large quantities of alcohol in one sitting) (Bourgault & Demers, 1997; Creswell et al., 2013; Holyfield et al., 1995), whereas its association with more normative levels of use tends to be unsupported (Bourgault & Demers, 1997; Keough et al., 2015, 2016). Furthermore, the literature clearly demonstrates that frequent solitary drinking relates to elevated risk for experiencing alcohol problems (Christiansen et al., 2002; Creswell et al., 2013; Keough et al., 2015; 2016). Based on the above literature, it is possible that frequent solitary drinking during the emerging adult undergraduate years reflects a loss of control over drinking. That is, those who engage in solitary drinking may not be able to limit their use to normative social contexts

(Holyfield et al., 1995), and may begin experiencing severe problems that presage the development of AUDs (Creswell et al., 2013). Accordingly, atypical solitary drinking in university may be associated with a pattern of severe alcohol problems that maps onto the types of problems observed in AUD. We speculate that solitary drinking (a clinically relevant, low base rate behavior among emerging adults) may be an early warning sign for the development of AUDs later in adulthood.

The purpose of the present study was to extend previous work on drinking context and overall problem risk (Christiansen et al., 2002; Keough et al., 2015, 2016; Gonzalez et al., 2009) by examining solitary drinking (versus normative social drinking) as a predictor of specific alcohol problems in emerging adults. We used the multidimensional Young Adult Alcohol Consequences Questionnaire (YAACQ; Read et al., 2006) to assess alcohol problems in our sample of emerging adult undergraduates. The YAACQ was designed to capture eight alcohol problem domains specifically encountered in emerging adulthood. Six of these domains reflect severe and core problems associated with AUDs (i.e., *social/interpersonal problems*, *impaired control*, *risky behaviors*, *academic/occupational problems*, *physical dependence symptoms*, and *blackout drinking*), while the remaining two domains (i.e., *diminished self-perception*, and *poor self-care*) capture comparatively less severe problems. Given that drinking alone is believed to be atypical and particularly risky at this stage of life, we predicted that frequent solitary drinking would be associated with specific, more severe problems on the YAACQ that map onto diagnostic criteria for AUDs. Because this is a relatively new area of investigation, we also explored the associations between solitary drinking and other alcohol problem domains. Finally, consistent with the literature, we expected that hazardous alcohol use would mediate the associations between solitary drinking and specific alcohol problems (Creswell et al., 2013).

## 2. Materials and Method

### 2.1. Procedure and Participants

Data for the current study were collected as part of the baseline for a lab-based study on motivation and drinking (Keough, O'Connor, & Colder, 2016). Given that the study included an alcohol cue-exposure, eligibility for the larger study were: (1) 18-25 years old; (2) full-time student; (3) not an alcohol abstainer (>1 drink per week); and (4) no history of very heavy alcohol use (<35 drinks per week). Study eligibility was assessed using a brief telephone screening. Participants received course credit or monetary (\$10/hour) compensation. The study sample included 118 undergraduates (68% women;  $M_{age}=21.15$  years,  $SD_{age}=2.70$ ) from English-speaking universities in Montreal. Many participants were European-Canadian (65%) and minority groups were Hispanic (8%), South Asian (7%), East Asian (6%), Middle Eastern (6%), African American (4%), and Aboriginal (4%).

### 2.2. Questionnaires

**2.2.1. Drinking Contexts.** Three items were adapted from Cooper's (1994) drinking contexts measure. Specifically, students rated how often they drank alone (i.e., solitary drinking) and how often they drank at parties and at bars (i.e., two contexts associated with normative social drinking) in the past 6 months. Responses were made on a 5-point scale (1=*almost never/never*; 5=*almost always/always*). Each single item was used in analyses.

**2.2.2. Alcohol Problems.** The Young Adult Alcohol Consequences Questionnaire (YAACQ; Read et al., 2006) was administered to assess eight alcohol problem domains: *social-interpersonal* (6-items), *impaired control* (6-items), *diminished self-perception* (4-items), *poor self-care* (8-items), *risky behavior* (8-items), *academic/occupational* (5-items), *physical dependence* (4-

items), and *blackout drinking* (7-items). Participants indicated whether or not they experienced each alcohol problem in the past year (0=no; 1=yes). Sum subscale scores were created. Previous work supports adequate to excellent internal consistencies for the YAACQ subscales ( $\alpha = .70-.91$ ) (Read et al., 2006). Also, in addition to assessing problems unique to emerging adulthood, the YAACQ was designed to capture the problems central to AUDs (DSM-IV, APA, 2000; Read et al., 2006). See Table 1 for current study internal consistencies, which were all acceptable to good.

**2.2.3. Hazardous Alcohol Use.** A measure of hazardous drinking was derived from the Alcohol Use Disorder Identification Test (AUDIT; Saunders et al., 1993). Specifically, the first three items of the AUDIT (referred to as the *AUDIT-Consumption* [AUDIT-C]) capture risky or hazardous drinking behaviors (e.g., “How often do you have six or more drinks on a single occasion?”). Response anchors range from 0 to 4, with higher scores reflecting more frequent hazardous use. Sum scores of  $\geq 3$  for women, and  $\geq 4$  for men on the AUDIT-C are considered positive for hazardous alcohol use. Previous work suggests that the AUDIT-C is a reliable and valid brief measure of hazardous drinking (Bush et al., 1998). The present study used AUDIT-C sum scores for participants and these were treated continuously in statistical models.

### 2.3. Data Analytic Overview

A path model was used to test the unique associations between drinking contexts (predictors) and eight alcohol problem domains (outcomes) via hazardous alcohol use (mediator). Consistent with best practices, we assessed overall model fit using several fit indices (Kline, 2013). Specifically, fit was considered excellent if the following guidelines were met:  $\chi^2/df$  ratio less than 3.0; Comparative Fit Index (CFI) greater than or equal to .95; Root Mean Square Error of Approximation (RMSEA) less than or equal to



.06; and a Standardized Root Mean Square Residual (SRMR) less than or equal to .08 (Hu & Bentler, 1999; Kline, 2010). Given the well-documented limitations of significance testing, especially among small samples and complex statistical models, we used effect sizes and 95% confidence intervals (*CI*s) to interpret paths and indirect effects in our model (Cohen, 1994; Kline, 2013; Lambdin, 2012). Accordingly, paths and indirect effects were considered to be supported if the 95% *CI* for the effect size did not include zero (Fritz & MacKinnon, 2007).

### 3. Results

#### 3.1. Data Screening

Several variables were non-normally distributed (skew >3.0; kurtosis >10) (Kline, 2013); this often occurs with drinking variables in non-clinical samples (Miller et al., 2002). To correct for this, we used robust maximum likelihood estimation (MLR) in MPlus 7.0 to calculate path coefficients and fit indices. MLR and bootstrapping are robust to violations of multivariate normality (Muthén & Muthén, 2012).

#### 3.2. Descriptive Statistics and Bivariate Correlations

See Table 1 for descriptive statistics and bivariate correlations. Compared to previous work with North American samples of undergraduate drinkers, our sample had comparable levels of hazardous alcohol use as measured by the AUDIT-C (Barry, Chaney, Stollefson, & Dodd, 2015; Demartini & Carey, 2012), but had slightly lower alcohol problems on the YAACQ (Merrill & Read, 2010). Also, it should be noted that the mean of the AUDIT-C in our sample falls in the positive screening range for hazardous alcohol

use. Means for solitary and social drinking were consistent with those in our previous work using a different sample of undergraduates (Keough et al., 2015; Keough et al., 2016).

### 3.3. Hypothesis Testing

Overall fit statistics supported excellent fit of the specified model:  $\chi^2 = 32.42$ ,  $df = 24$ ,  $\chi^2/df = 1.35$ ;  $CFI = 0.98$ ;  $RMSEA = 0.05$  (90%  $CI$  [0.00, 0.10]);  $SRMR = 0.05$  (see Figure 1). Effects from drinking context to hazardous use and from hazardous use to alcohol problem domains represent unique associations after controlling for overlapping or shared variance.  $CI$ s for these effects showed that solitary drinking was a positive predictor of hazardous drinking, but  $CI$ s did not support associations between social drinking contexts (at parties and at bars) and hazardous alcohol use. Further,  $CI$ s showed that hazardous alcohol use was a positive predictor of all eight domains of alcohol problems.

Bias corrected 95% bootstrapped  $CI$ s were used to evaluate indirect effects from solitary and social drinking to alcohol problems via hazardous use (see Table 2). Overall,  $CI$ s showed that solitary drinking positively predicted all domains of alcohol problems through hazardous alcohol use. The pattern of effect sizes for these indirect associations showed that solitary drinking was a particularly strong predictor of alcohol problem domains involving risky behaviors and blackout drinking (two severe problems associated with AUDs), as well as poor self-care. Each of these pathways explained more than 20% of the variance in the three problem outcomes. Although the 95%  $CI$ s did not support direct effects from social drinking contexts (bars and parties) to hazardous alcohol use, in line with recent recommendations (Hays, 2009; Zhao, Lynch & Chen, 2010) we report the  $CI$ s for corresponding indirect effects. The  $CI$ s supported indirect effects from social drinking at parties to four domains of alcohol problems (more severe:

academic/occupational problems and physical dependence; less severe: diminished self-perception and poor self-care) via hazardous alcohol use. Indirect effects were smaller than the corresponding pathways from solitary drinking to these problem domains. There were no supported indirect effects from social drinking at bars to alcohol problems via hazardous use.

#### 4. Discussion

Our primary goal in the present study was to examine solitary drinking as an antecedent to specific (and more severe) alcohol problems in emerging adult undergraduates. Extant research suggests that frequent solitary drinking during the university years – a time when alcohol use normatively occurs in social settings – represents a loss of control over drinking and may be an early indicator of problem drinking habits that presage AUDs (Abbey et al., 1993; Gonzalez et al., 2012; Keough et al., 2015). Accordingly, we expected solitary (relative to social) drinking to be uniquely associated with alcohol problem domains that map onto those observed in AUDs. Further, we expected these associations to be explained by hazardous levels of alcohol use. Overall, our hypotheses were supported; solitary drinking was associated with all of the alcohol problem domains through hazardous drinking, with indirect effects being strongest for severe problems of risky behaviors and blackout drinking, and for a comparative less severe problem of poor self-care. In contrast, two contexts associated with normative social drinking among emerging adult undergraduates were not associated with hazardous drinking. However, some evidence from mediational analyses did support indirect effects from social drinking at parties to certain domains of alcohol problems via hazardous use. Though, these pathways were comparatively smaller than those observed for solitary drinking. These findings fit with the extant literature on the differential risks associated with different contexts

for drinking (Christiensen et al., 2002; Keough et al., 2015). Findings in our sample indicate that solitary drinking is particularly risky in emerging adulthood and may increase risks for AUDs.

We found support for the mediational role of hazardous alcohol use in solitary drinking pathways to alcohol problems. This is in contrast to some of our previous work (Keough et al., 2015; 2016) showing that solitary drinking was unrelated to levels of alcohol use, but was related to overall problems. It should be noted that the present study differs from our existing work in one key way: we assessed hazardous levels of alcohol use (via the AUDIT-C) *rather* than typical weekly drinking. Subsequently, we observed differential associations with drinking context, with solitary drinking being uniquely associated with hazardous drinking. One possibility is that solitary drinking may reflect a more persistent and serious style of drinking among emerging adults in university settings. Frequent solitary (relative to social) drinking is an atypical behaviour in emerging adulthood, and may reflect greater levels of psychopathology at this stage of life. To illustrate, frequent solitary drinkers tend to experience higher levels of depression, social anxiety, and suicidal ideation relative to social drinkers (Christiansen et al., 2002; Gonzalez et al., 2009; Keough et al., 2015; Keough et al., 2016). Due to these difficulties, they may withdraw from peers and drink hazardously to self-medicate negative emotions. Over time, this pattern of hazardous use may increase risk for AUDs. Future work should examine the predictive (or precursory) impacts of depression and social anxiety on solitary drinking pathways to specific alcohol problems among emerging adults.

Despite the lack of direct associations between social drinking and hazardous alcohol use in our model, results for indirect effects showed that social drinking at parties (but not at bars) may relate to alcohol problem risk among young adults. Indirect path estimates showed that social drinking at parties was associated with severe problems of academic/occupational consequences, and

physical dependence and also with comparatively less severe problems of diminished self-perception and poor self-care. However, these effects should be interpreted with caution. Specifically, we observed that solitary drinking was associated with hazardous drinking (as per the 95% *CI*s). Comparatively, the path from social drinking at parties to hazardous alcohol use was weak and was not supported by the *CI* for the direct effect. Accordingly, it is possible that the indirect effects for social drinking at parties were driven mainly by the strong associations between the mediator (hazardous use) and the outcomes (alcohol problem domains). Nevertheless, social drinking at parties may be a risky context for specific alcohol problems in undergraduates. One potential difference between social drinking at parties (which we found to be potentially risky) versus at bars (which we did not find to be risky) is the composition of the social drinking group. At bars, undergraduates may find themselves among strangers, which may serve to deter hazardous drinking. This may be especially true for the high percentage of undergraduates with social anxiety (Keough et al., 2016). In contrast, drinking companions at parties may be more likely to friends and acquaintances, and hence, undergraduates may feel more comfortable drinking heavily. In turn, this may increase risk for alcohol problems. Overall, pathways from social drinking to alcohol problems need to be replicated in future research – especially in light of our small sample size.

The results of our study have clinical implications. Clinicians working with students in university settings should screen for frequency of solitary drinking and related problems. Mounting evidence suggests that solitary drinking is particularly problematic in young people (Bourgault & Demers, 1997; Gonzalez et al., 2012) and early identification may not only reduce immediate problem drinking, but may prevent the escalation into AUDs later in life (Abbey et al., 1993). Psychoeducation about the risks of solitary drinking and about safe drinking practices should be discussed with students seeking support for problem drinking.

The cross sectional nature of this study limits firm conclusions about the directionality of our effects. For example, we cannot rule out the possibility of the reverse relation, i.e., those who experience more severe alcohol problems (risky drinking and blackout drinking) tend to become more reclusive and to drink alone. Despite this limitation, we are among the first to examine predictors of specific alcohol problems in emerging adults (Merrill & Read, 2010; Merrill et al., 2014). While our results need to be replicated in future experimental and longitudinal studies, our study is useful because it identifies solitary drinking as a potential target for early intervention and prevention programs for emerging adults in university settings. Our findings are also consistent with the speculation that solitary drinking may be an important factor that contributes to the development and progression of AUDs over time (Creswell et al., 2013). A second limitation is that we had a relatively small sample size. This may have limited our power to detect some associations in the present study, especially those of small magnitude. Nonetheless, given our small sample and model complexity, our results should be viewed as preliminary support for solitary drinking pathways to alcohol problems that need further testing in large samples of undergraduates. Finally, our small sample size of men (vs. women) precluded testing sex-specific pathways to specific alcohol problems.

## 5. Conclusions

In sum, our findings support the notion that solitary and social drinking contexts are associated with distinct patterns of alcohol problems among emerging adults. Solitary drinking was linked to a host of alcohol problems, and showed particularly strong associations to two severe types of alcohol problems: risky drinking and blackout drinking. Comparatively, social drinking was not associated with hazardous alcohol use. However, tests of mediation suggested that social drinking at parties (but not bars) may

increase risk for certain alcohol problems among emerging adults, those these were comparatively smaller than those observed for solitary drinking. Results suggest that it is important for clinical interventions to include discussion of context-related risk in emerging adulthood. This may involve psychoeducation, as well as targeted strategies to reduce problems associated with solitary drinking.

### **Role of Funding Sources**

This work was funded by a CIHR Operating Grant awarded to Roisin M. O'Connor. During completion of this project, Matthew T. Keough was supported by a Vanier Canada Graduate Scholarship from the Canadian Institutes of Health Research (CIHR), and Roisin M. O'Connor was supported in-part by a CIHR New Investigator Award. Sherry H. Stewart is supported by a Tier 1 CIHR Canada Research Chair in Addictions and Mental Health. The financial support had no role in the study design, collection, analysis or interpretation of the data, writing the manuscript, or the decision to submit the manuscript for publication.

### **Contributors**

All authors contributed meaningfully to the conceptual model presented in the manuscript. Matthew T. Keough conceptualized and ran the larger study; collected and analyzed the data; conducted literature searches and wrote the first draft of the manuscript. Drs. O'Connor and Stewart provided constant and significant feedback on all aspects of the paper. The final manuscript reflects the combined substantial effort of all co-authors and together we declare that we approve of this submission.

### **Conflict of Interest**

All authors declare that they have no conflicts of interest.

### **Acknowledgements**

N/A

## References

- Abbey, A., Smith, M.J., & Scott, R.O. (1993). The relationship between reasons for drinking alcohol and alcohol consumption: An interactional approach. *Addictive Behaviors, 18*, 659-670.
- Adlaf, E.M., Demers, A., & Gliksman, L. (2005). *Canadian Campus Survey 2004*. Toronto, ON: Centre for Addiction and Mental Health.
- Barry A. E., Chaney B. H., Stellefson M. L., Dodd V. (2015) Evaluating the psychometric properties of the AUDIT-C among college students. *Journal of Substance Use, 20*, 1–5.
- Bourgault, C., & Demers, A. (1997). Solitary drinking: A risk factor for alcohol-related problems? *Addiction, 92*(3), 303-312.
- Bush, K., Kivlahan, D.R., McDonell, M.B., Fihn, S.D., & Bradley, K.A. (1998). The AUDIT alcohol consumption questions (AUDIT-C): an effective brief screening test for problem drinking. Ambulatory Care Quality Improvement Project (ACQUIP). Alcohol Use Disorders Identification Test. *Archives of Internal Medicine, 158*(16), 1789-1795.
- Christiansen, M., Vik, P. W., & Jarchow, A. (2002). College student heavy drinking in social contexts versus alone. *Addict. Behav., 27*(3), 393-404.
- Cohen, J. (1994). The earth is round ( $p < .05$ ). *American Psychologist, 49*, 997-1003.
- Cooper, M. L. (1994). Motivations for alcohol use among adolescents: Development and validation of a four-factor model. *Psychological Assessment, 6*, 117-128.



- Creswell, K. G., Chung, T., Clark, D. B., & Martin, C. S. (2013). Solitary Alcohol Use in Teens Is Associated With Drinking in Response to Negative Affect and Predicts Alcohol Problems in Young Adulthood. *Clinical Psychological Science*, 2167702613512795.
- DeMartini K. S., Carey K. B. (2009) Correlates of AUDIT risk status for male and female college students. *Journal of American College Health*, 58, 233–239.
- Fritz, M. S., & MacKinnon, D. P. (2007). Required sample size to detect the mediated effect. *Psychological Science*, 18, 233-239.
- Gonzalez, V.M., Collins, L.R., & Bradizza, C.M. (2009). Solitary and social heavy drinking, suicide ideation, and drinking motives in underage college drinkers. *Addictive Behaviors*, 34, 993-999.
- Gonzalez, V. M., & Skewes, M. C. (2012). Solitary heavy drinking, social relationships, and negative mood regulation in college drinkers. *Addiction Research & Theory*, 21(4), 285-294.
- Holyfield, L., Ducharme, L. J., & Martin, J. K. (1995). Drinking contexts, alcohol beliefs, and patterns of alcohol consumption: Evidence for a comprehensive model of problem drinking. *The Journal of Drug Issues*, 25, 783–798.
- Hu, L. T., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling*, 6, 1-55.
- Johnston, L.D., O'Malley, P.M., & Bachman, J.G. (1998). The development of heavy drinking and alcohol-related problems from ages 18 to 37 in a U.S. national sample. *Journal of Studies in Alcohol*, 61, 290–300.

- Keough, M.T., Battista, S.R., O'Connor, R.M., Sherry, S.B., & Stewart, S.H. (2016). Getting the Party Started - Alone: Solitary Predrinking Mediates the Association Between Social Anxiety and Alcohol-Related Problems. *Addictive Behaviors*, *55*, 19-24.
- Keough, M.T., O'Connor, R.M., Sherry, S.B., & Stewart, S.H. (2015). Context Counts: Solitary Drinking Explains the Association between Depressive Symptoms and Alcohol-related Problems in Undergraduates. *Addictive Behaviors*, *42*, 216-221.
- Keough, M.T., O'Connor, R.M., & Colder, C.R. (2016). Testing the Implicit and Explicit Cognitions Underlying BIS-related Drinking in Young Adults. *Alcoholism: Clinical and Experimental Research*, *40*(5), 1065-1074.
- Kline, R. B. (2013). *Beyond significance testing* (2nd ed.). Washington, DC: American Psychological Association.
- Kline, R. B. (2010). *Principles and practice of structural equation modeling*. Guilford Press, New York.
- Kuntsche, E., Knibbe, R. A., Gmel, G., & Engels, R.C.M.E. (2005). Why do young people drink? A review of drinking motives. *Clinical Psychology Review*, *25*, 841–861.
- Lambdin, C. (2012). Significance tests as sorcery: Science is empirical—significance tests are not. *Theory & Psychology*, *22*, 67–90.
- Magid, V., MacLean, M. G., Colder, C. R. (2007). Differentiating between sensation seeking and impulsivity through their mediated relations with alcohol use and problems. *Addictive Behaviours*, *32*, 2046-2061.
- Merrill, J.E., & Read, J.P. (2010). Motivational pathways to unique types of alcohol consequences. *Psychology of Addictive Behaviors*, *24*(4), 705-711.
- 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*(1), 93-102.

- Miller, B.E., Miller, M.N., Verhegge, R., Linville, H.H., & Pumariega, A.J. (2002). Alcohol misuse among college athletes: Self-medication for psychiatric symptoms? *J. Drug Educ.*, *32*, 41-52.
- Muthén, L.K., & Muthén, B.O. (2012). *Mplus user's guide: Version 7*. Los Angeles, CA: Muthén and Muthén.
- Neff, J.A. (1997). Solitary drinking, social isolation, and escape drinking motives as predictors of high quantity drinking, among Anglo, African American, and Mexican American males. *Alcohol and Alcoholism*, *32*, 33-41.
- Nelson, C.B., Little, R.J.A., Heath, A.C., & Kessler, R.C. (1996). Patterns of DSM-III-R alcohol dependence symptom progression in a general population survey. *Psychological Medicine*, *26*, 449-460.
- O'Hare, T. M. (1990). Drinking in college: Consumption patterns, problems, sex differences and legal drinking age. *Journal of Studies on Alcohol*, *51*, 536-541.
- Pihl, R. O., Peterson, J. B. (1995). Alcoholism: The role of different motivational systems. *J. Journal of Psychiatry & Neuroscience*, *20*, 372-396.
- Read, J.P., Kahler, C.W., Strong, D.R., & Colder, C.R. (2006). Development and preliminary validation of the Young Adult Alcohol Consequences Questionnaire. *Journal of Studies in Alcohol*, *67*, 169-177.
- Saunders, J.B., Aasland, O.G., Babor, T.F., de la Fuente, J.R., & Grant, M. (1993). Development of the Alcohol Use Disorders Identification Test (AUDIT): WHO Collaborative Project on Early Detection of Persons with Harmful Alcohol Consumption—II, *Addiction*, *88*, 791-803.

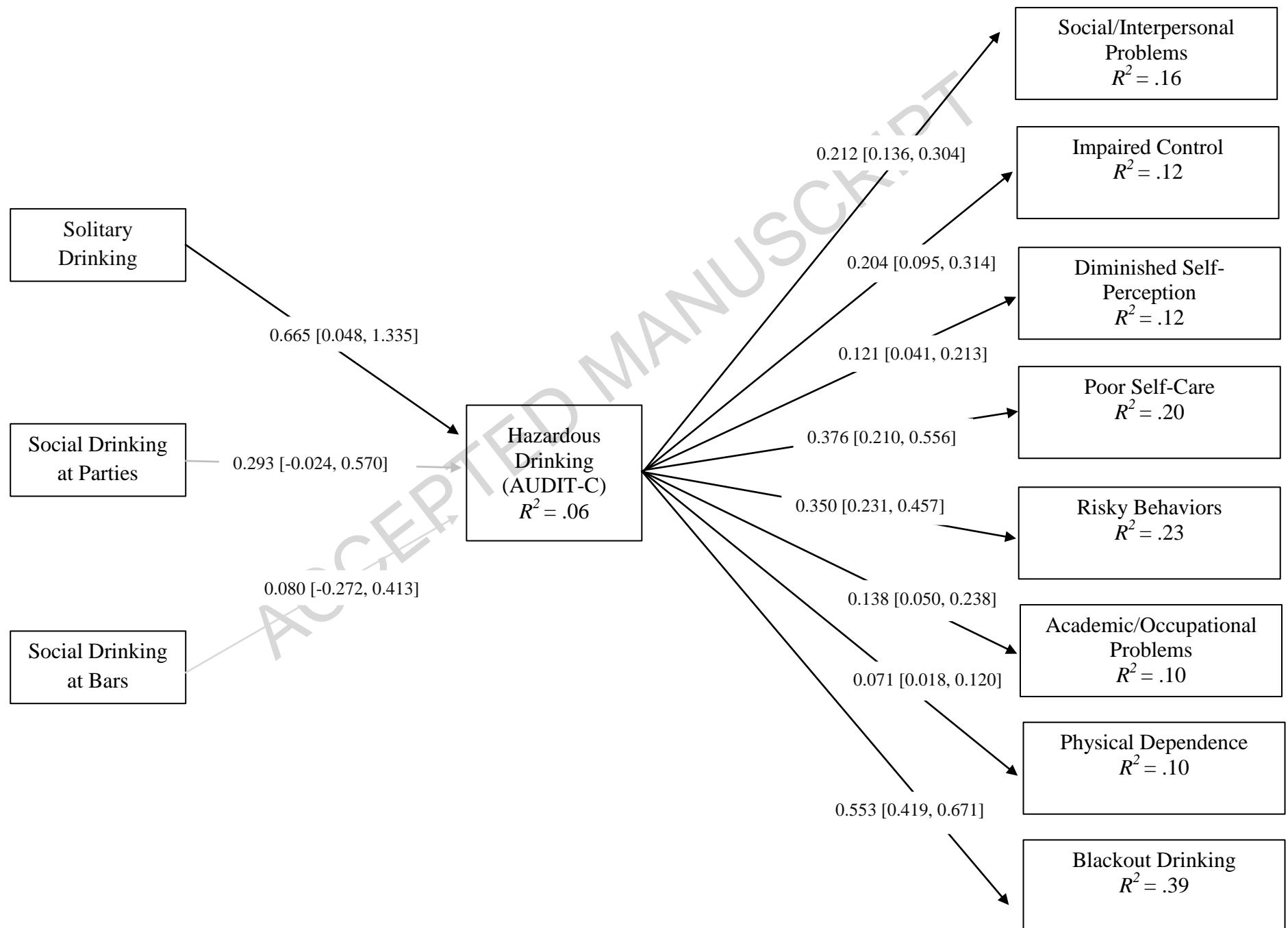
Table 1 Descriptive Statistics and Bivariate Correlations

	1	2	3	4	5	6	7	8	9	10	11	12
1. Solitary Drinking	-	-.22	-.02	.08	.07	.10	.13	.06	.16	.32	.13	.17
2. Social Drinking at Parties		-	.29	.07	.03	.12	.07	-.07	-.06	-.15	.10	.13
3. Social Drinking at Bars			-	.12	.09	.11	.12	.02	.12	.13	.15	.08
4. Social/interpersonal Problems				-	.39	.29	.46	.59	.27	.09	.57	.40
5. Impaired Control					-	.38	.52	.54	.36	.20	.45	.35
6. Diminished Self-Perception						-	.40	.24	.21	.11	.28	.26
7. Poor Self-Care							-	.50	.56	.20	.53	.45
8. Risky Behaviors								-	.30	.16	.68	.48
9. Academic/Occupations Problems									-	.18	.33	.31
10. Physical Dependence										-	.29	.30
11. Blackout Drinking											-	.62
12. Hazardous Drinking (AUDIT-C)												-
<i>M</i>	1.36	3.71	2.83	1.47	1.12	0.47	1.11	1.22	0.49	0.24	2.26	4.00
<i>SD</i>	0.59	1.11	1.00	1.01	1.09	0.85	1.57	1.38	0.85	0.44	1.68	1.89
<i>α</i>	-	-	-	0.89	0.88	0.82	0.82	0.85	0.79	0.72	0.88	0.82

Table 2 Summary of Indirect Effects from Drink Contexts to Specific Alcohol Problems

Path	Unstandardized Estimate	95% CI
Solitary Drinking → Hazardous Drinking → Social/Interpersonal Problems	*0.141	[0.013, 0.336]
Solitary Drinking → Hazardous Drinking → Impaired Control	*0.135	[0.015, 0.332]
Solitary Drinking → Hazardous Drinking → Diminished Self-Perception	*0.081	[0.008, 0.214]
Solitary Drinking → Hazardous Drinking → Poor Self-Care	*0.250	[0.022, 0.650]
Solitary Drinking → Hazardous Drinking → Risky Behaviors	*0.233	[0.016, 0.526]
Solitary Drinking → Hazardous Drinking → Academic/Occupational Problems	*0.092	[0.009, 0.274]
Solitary Drinking → Hazardous Drinking → Physical Dependence	*0.047	[0.003, 0.141]
Solitary Drinking → Hazardous Drinking → Blackout Drinking	*0.368	[0.038, 0.803]
Social Drinking at Parties → Hazardous Drinking → Social/Interpersonal Problems	0.062	[-0.004, 0.131]
Social Drinking at Parties → Hazardous Drinking → Impaired Control	0.060	[-0.001, 0.136]
Social Drinking at Parties → Hazardous Drinking → Diminished Self-Perception	*0.035	[0.001, 0.101]
Social Drinking at Parties → Hazardous Drinking → Poor Self-Care	*0.110	[0.001, 0.237]
Social Drinking at Parties → Hazardous Drinking → Risky Behaviors	0.102	[-0.003, 0.207]
Social Drinking at Parties → Hazardous Drinking → Academic/Occupational Problems	*0.040	[0.004, 0.097]
Social Drinking at Parties → Hazardous Drinking → Physical Dependence	*0.021	[0.002, 0.055]
Social Drinking at Parties → Hazardous Drinking → Blackout Drinking	0.162	[-0.012, 0.342]
Social Drinking at Bars → Hazardous Drinking → Social/Interpersonal Problems	0.017	[-0.051, 0.094]
Social Drinking at Bars → Hazardous Drinking → Impaired Control	0.016	[-0.052, 0.091]
Social Drinking at Bars → Hazardous Drinking → Diminished Self-Perception	0.010	[-0.032, 0.060]
Social Drinking at Bars → Hazardous Drinking → Poor Self-Care	0.030	[-0.091, 0.176]
Social Drinking at Bars → Hazardous Drinking → Risky Behaviors	0.028	[-0.086, 0.159]
Social Drinking at Bars → Hazardous Drinking → Academic/Occupational Problems	0.011	[-0.031, 0.073]
Social Drinking at Bars → Hazardous Drinking → Physical Dependence	0.006	[-0.014, 0.037]
Social Drinking at Bars → Hazardous Drinking → Blackout Drinking	0.044	[-0.133, 0.240]

*Note.* Covariances were estimated among alcohol problem domains. \*indicates the 95% CIs that do not contain zero.



## Figure Caption

*Figure 1.* The final path model for pathways from drinking contexts to alcohol problems via hazardous alcohol use. Unstandardized parameter estimates are presented with 95% *CI*s. Dark lines reflect specified paths that were supported (i.e., the 95% *CI* did not include zero) and grey lines reflect specified paths that were not supported (i.e., the 95% *CI* included zero).

### Highlights

- We test the associations between drinking contexts and specific alcohol problems.
- We show that solitary is linked to a host of severe problems in emerging adulthood.
- Solitary drinking was linked to hazardous alcohol use.
- Solitary drinking should be a target of alcohol interventions in emerging adulthood.