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The Effects of Drinking on University Grades: Does Academic Motivation Play a
Role?

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Abstract

Past research has shown that heavy episodic drinking by college students is associated with decreased academic achievement. The purpose of this study was to test academic motivation as a mediator for the relationship between drinking and academic achievement. It was hypothesized that heavy episodic drinking decreases academic motivation, which subsequently decreases academic achievement. Four hundred and fifteen first-year students (255 female, 160 male) completed 26 weekly online questionnaires about their drinking behaviours and academic motivation. Academic motivation was found to mediate the drinking - achievement relationship for mean number of drinks and heavy episodic drinking, but only for females. Also, students in different faculties differed in their levels of drinking and academic motivation.

Acknowledgment and Dedication

I would like to thank Dr. Tremblay for all of the patience, guidance, and time he dedicated to me during this project. It was a pleasure to work with him!

The Effects of Drinking on University Grades: Does Academic Motivation Play a Role?

Post-undergraduate success is becoming increasingly difficult for college students, as competition in the workforce is fierce (Miller & Slocombe, 2012). Now more than ever, academic achievement is important to a student's success in many facets of post-undergraduate life: acceptance to graduate and professional programs, career opportunities, and future earning potential. Academic achievement can be influenced by a number of factors, and the effect of alcohol consumption on achievement has been of particular interest to researchers. Researchers have found an association between heavy episodic student drinking and decreased academic achievement (Pascarella et al., 2007; Singleton, 2007; DeBerard, Spielmans, & Julka, 2004; Porter & Pryor, 2007), with current research focused on empirically determining variables that mediate this relationship.

A high frequency of college and university students drink regularly. In Canada, over 6000 full-time students were surveyed in 2005 using the World Health Organization's Alcohol Use Disorders Identification Test screener, and 32% of respondents (37.6% males, 27.5% females) reported harmful or hazardous drinking (Adlaf, Demers, & Gliksman, 2005). In addition, almost one-third of respondents reported heavy drinking, which, in this study, consisted of weekly drinking, and/or consumption of six or more drinks on each occasion of drinking (Adlaf et al., 2005). Negative consequences were reported by the students who drank: 31.6% reported being unable to perform daily activities, 18.8% reported missing class, and 32.9% reported study interruptions (Adlaf et al., 2005). Empirical evidence has shown a link between heavy episodic drinking (HED) and academic achievement. In particular, students who engage in HED tend to have decreased grades.

Singleton and Wolfson (2009) tested whether sleeping patterns and daytime sleepiness are mediating factors in the high drinking - low achievement relationship. They wanted to test unhealthy behaviours, like unhealthy sleep patterns, because they may be linked to behavioural consequences (Buboltz et al., 2006). They found that students who regularly drink have interrupted sleep cycles: they go to bed late, wake up late, and experience increased daytime sleepiness, all factors of which were found to be associated with decreased academic performance.

Other researchers have found associations between HED in students and decreased class attendance (Wechsler, Dowdall, Maenner, Gledhill-Hoyt, & Lee, 1998), falling behind on readings and assignments (Wechsler et al., 1998), decreased time spent studying (Wechsler, Dowdall, Davenport, & Castillo, 1995), and decreased interest in school (Bryant, Schulenberg, O'Malley, Bachman, & Johnston, 2003). These variables may also contribute as mediators in the drinking - achievement relationship because they may explain why drinking is associated with decreased achievement.

Drinking Patterns in College Students Throughout the Academic Year

When measuring student drinking patterns, researchers generally survey students on the volume of drinks consumed over a certain time period (e.g., one week). However, other drinking patterns can also be assessed by the following measures: looking at the largest number of drinks consumed at one time point in the past 30 days, or looking at HED. HED is defined as consuming five or more drinks in a row for men, and four or more drinks in a row for women in one time period. Researchers can also measure problem drinking by asking participants about negative consequences experienced as a function of drinking. The present study will analyze the mean number of drinks consumed and the prevalence of HED each week.

Most research has measured student drinking patterns at one time only in the academic year. Data collected only once may not represent the average, or normal, drinking behaviours of students. Perhaps during the data collection period students had a celebratory event, or were sick, and their levels of drinking were higher or lower than their typical levels on a week-to-week basis. Tremblay et al. (2010) conducted a longitudinal study and measured student drinking patterns throughout the academic year to obtain a more precise measure of student drinking behaviours. Additionally, this longitudinal study offered insight into gender differences and similarities, HED, and patterns of daily and weekly drinking behaviour throughout the year. A weekly online survey was administered to first-year students and 26 weeks of data were obtained regarding their drinking behaviours.

In general, males and females had similar drinking behaviours, but males always drank more than females. Similar patterns were found for HED behaviours. During a typical week, drinking was minimal on Monday, and increased from Tuesday through Saturday, peaking on Saturday, and declining back to Monday's levels on Sunday. So, when examining weekly drinking habits, a spike in drinking occurred each weekend. Tremblay et al. (2010) also found specific times throughout the year in which drinking was high or low. High instances of drinking occurred at the beginning of each semester (early September and January), Halloween weekend, Halloween Day, New Year's Eve, and St. Patrick's Day. Low instances of drinking occurred during December exams, but not during April exams (perhaps because of end-of-year parties during the April exam period). This study, conducted in Canada, found similar results to the American longitudinal student drinking patterns study by Del Boca, Darkes, Greenbaum, and Goldman (2004). To summarize, Tremblay et al. (2010) expanded current knowledge of college

student drinking behaviours by determining that the amount of student drinking differs throughout the academic year.

Knowing that drinking behaviours increase or decrease at specific times during the academic year is beneficial when implementing prevention programs to decrease overall drinking in college students. Thus, longitudinal studies that test weekly behaviours are valuable to determine the best time to implement a prevention program. These programs can be especially helpful for students to maximize their academic potential because of the established relationship between drinking and academic achievement.

Drinking and Academic Achievement

Researchers have consistently found that college students engaged in HED likely have decreased grades. Pascarella et al. (2007) administered a survey to college students, measuring engagement in HED over a period of two weeks and cumulative GPA scores. They found that students who engaged in HED two or more times had lower GPA scores compared to those who did not engage in HED. The magnitude of the effect increased with each additional occasion of heavy drinking during the two weeks. This negative relation between HED and grades was similar for males and females.

Singleton (2007) interviewed college students and measured their HED over a two-week period and their academic achievement (average grades during the semester of testing and cumulative GPA scores). He found an association between HED and decreased academic achievement in both the short and long-term and also reported that academic achievement decreased even more when students participated in partying activities.

DeBerard, Spielmans, and Julka (2004) questioned college students about their drinking behaviours (whether they had five or more drinks in one day during the past month) and

academic achievement (cumulative GPA scores) and found HED to be associated with poor academic achievement.

Porter and Pryor (2007) found undergraduate students who engaged in HED to have lower GPA scores. They found that the greater number of occasions of HED during the measurement period, the higher the likelihood of lower academic achievement. One reason Porter et al. (2007) provided to explain the occurrence of this association considers the relationship between students and university faculty. They explained how engagement with faculty could predict student achievement, but it is unclear whether high engagement protects students from HED, or whether HED prevents students from engaging with faculty members. Porter et al. (2007) also wrote that heavy episodic drinkers spend less time studying and more time taking part in recreational activities and sports.

Drinking and Academic Motivation

Given the evidence for an existing relationship between engagement in HED and decreased academic achievement, an important next step in current research would be to investigate the mechanisms and identify variables that explain the high drinking – low achievement relation. It is possible that academic motivation, as defined by the effort students apply to their studies, may serve as a mediator between drinking and academic achievement. Research has clearly shown that academic motivation is related to academic achievement (Svanum & Bigatti, 2006; Rau & Durand, 2000). As will be reviewed below, drinking is also related to academic motivation, and therefore it seems reasonable to hypothesize that HED leads to decreased academic motivation, subsequently leading to decreased grades.

Multiple researchers have found an association between drinking and academic motivation. Rhoades and Maggs (2006) administered a questionnaire to incoming first-year

college students asking about their planned drinking behaviours and academic goals in their first year of college. Results showed that students who were academically motivated planned to drink less alcohol. Wechsler, Dowdall, Davenport, and Castillo (1995) surveyed students from 140 colleges and found that college students were more likely to engage in HED when they rated their schoolwork as not important and when they spent less than four hours studying each day. Simons, Christopher, and McLaury (2004) administered two questionnaires 30 days apart, and asked students about their drinking in the past 30 days, as well as their achievement goals. In their study, having achievement goals meant that participants would be concerned with their accomplishment, effort, and success related to achieving those goals. College students who had achievement goals engaged in HED less than students with no achievement goals. Wolaver (2002) surveyed college students and found that, regardless of their frequency of drinking, students who drink study less and are likely to have lower GPA scores than non-drinkers.

Gender as a moderator of the drinking - motivation relationship. As previously discussed, men and women have similar drinking behaviours, but men consistently drink more than women. When assessing drinking and academic motivation between each gender, differences have been found. Vaughan, Corbin, and Fromme (2009) conducted a longitudinal study, surveying college students at the end of each semester for two years, and found women who were academically motivated drank less. For these women, academic motivation served as a protective factor against drinking. This did not occur for men: academically motivated men still drank. So, the possibility exists that drinking may affect academic motivation for men only. Webb, Moore, Rhatigan, Stewart, and Getz (2007) asked high-school students about their drinking behaviours in the past month and also found a gender difference. Drinking and academic motivation were associated for men, but not women. Li, Frieze, Nokes-Malach, and

Cheong (2013) surveyed college students about their drinking behaviours within the past week and the past 30 days, and also assessed academic motivation by measuring the effort students put into their studies. A gender difference was found between drinking and academic motivation for men and women. For men, drinking was associated with decreased academic motivation, but for women, the level of drinking did not correlate with academic motivation.

Academic Motivation as a Mediator of the Drinking - Achievement Relationship

Further research is necessary to understand the nature of the high drinking - low achievement relationship and to find an explanation for its occurrence. The goal of this study will be to examine whether academic motivation serves as a mediator for this existing relationship. In other words, this study will test the following question: Do students who engage in HED put less effort into their studies, resulting in decreased academic achievement?

Using the data from the Tremblay et al. (2010) study of 415 first-year university students at Western, the present study will examine three main variables over a period of 26 consecutive weeks: drinking, academic motivation, and academic achievement as well as variables for secondary analyses including gender and faculty program. Two types of drinking variables will be included: mean number of drinks and HED (engaging in at least one occasion/day with 4+ drinks for women and 5+ drinks for men in the previous week). Also, to measure academic motivation, each week, students were asked to report how hard they worked on their studies during the previous week. Academic achievement will be measured by final average grades at the end of the academic year.

HED is expected to decrease academic achievement, and academic motivation is expected to mediate that relationship. Also, it is expected that academic motivation will more strongly affect this relationship in men. Previous research has shown that HED in men has been

associated with decreased academic motivation (Vaughan et al., 2009; Webb et al., 2007; Li et al., 2013). In women, HED and academic motivation do not seem to have as strong a relationship (Webb et al., 2007; Li et al., 2013). Furthermore, Pascarella et al. (2007) indicated that no gender differences exist between drinking and decreased academic achievement.

Previous studies that measured drinking behaviours at one time-point only may not be an accurate measure of a student's drinking habits. Surveying students' drinking behaviours over a 26-week period provides researchers with a more accurate and precise measure of overall drinking behaviour. The same logic can apply to students' academic motivation.

The large dataset that will be used for analysis in this study allows for multiple ways of investigating academic motivation as a mediator to the drinking - achievement relationship. The relationship can be studied on a week-to-week basis, measures of drinking and academic motivation can also be aggregated to get overall drinking and motivation scores across the academic year, or analyses can be conducted to determine whether drinking in a given week affects motivation in the following week.

Drinking and Faculty Program

Whether drinking behaviours are associated with students' faculty program is an area of research that has not received much attention. Some college faculties explicitly promote a "work hard play hard" mentality, while others do not appear to facilitate any relation between schoolwork and drinking. Wolaver (2002), the pioneer in this area of research, found heavy episodic drinkers to be more likely to study social sciences and business, over natural sciences, education, or engineering. The test between drinking and faculty program is exploratory, as only this one study has been conducted on the relationship between those variables. If an association does exist between faculty program and drinking behaviours throughout the academic year,

prevention programs can be tailored to faculty-specific events, rather than the general student population.

Method

The data used to analyze the present study's research question will be obtained from a larger study conducted by Tremblay et al. (2010). In that study, three phases of data were collected. In Phase 1, students completed an online baseline questionnaire. In Phase 2, students completed 26 weekly online questionnaires. In Phase 3, students completed up to 24 monthly online questionnaires. Phases 1 and 2 will be described in greater detail below, but most attention will be focused on Phase 2, as data analysis for the present study will use data from this phase only.

Participants

Phase 1. A total of 848 first-year university students at the University of Western Ontario (UWO) completed the baseline questionnaire at the beginning of the academic year (September 2006). There were 304 males (35.9%) and 543 females (64.1%), and one participant did not indicate his or her gender, and was excluded.

Phase 2. A total of 415 students, all of who completed the baseline questionnaire, participated in Phase 2 (beginning in October 2006). There were 266 females (64.1%) and 149 males (35.9%) in the following age groups: 16, 17, 18, 19, 20, and 21 or older. The mean age was 18.42 ($SD = 2.40$). Students of White ethnicity comprised the majority of participants (72.6%), followed by Chinese (10.3%), South Asian (3.2%), Arab-West Indian (1.7%), and Korean (1%) students. The remainder of the participants (11.2%) were Multiracial or did not specify their ethnicity.

Materials

Alcohol Consumption Measures. In Phase 2, participants were asked to list the number of alcoholic drinks (i.e., one 341 ml [12 ounce] bottle or glass of beer [regular strength 5% alc], one 150 ml [5 ounce] glass of wine, one mixed drink with 45 ml [1.5 ounces] of spirits [e.g., vodka, rum, rye, scotch, gin], or one 341 ml [12 ounce] alcohol cooler, wine cooler, or premixed drink [e.g., Mike's Hard Lemonade, Smirnoff Ice, Bacardi Silver, Bacardi Breezer, Long Island Iced Tea, Vibe, and so on]) they consumed on each day of the past week (Monday to Sunday). From this information, two measures were derived. The first consists of the mean number of drinks per week (averaged over the 26 weeks). The second, labelled Heavy Episodic Drinking (HED), was derived, firstly, by determining on how many days of a given week (0-7), a person consumed five or more drinks in a day (for males) or four or more drinks in a day (for females). Given the relatively small proportion of people who reported HED more than once per week, the HED variable was dichotomized at 0 for none and 1 for at least one HED episode in a given week. The HED total was then calculated as the proportion of HED weeks over reported weeks (i.e., 26 weeks for those with complete data). See Appendix A for further details.

Academic Motivation Measure. In Phase 2, participants were asked to report in the past week (Monday to Sunday) whether they worked hard on their studies. Responses were measured on a Likert scale from 0 (*very strongly disagree*) to 10 (*very strongly agree*). See Appendix A for further details.

Academic Achievement Measure. Final average grades over all courses completed in the first academic year were obtained from the Registrar at UWO.

Procedure

Phase 1. In Phase 1, an e-mail invitation was sent to all first-year UWO students ($N = 4884$) to complete an online baseline questionnaire. The e-mail led participants to a secure Web

site that contained information and consent letters, a debriefing form, a list of services for those in distress, and the online questionnaire. Two reminder emails were sent during the two weeks of data collection. Questionnaire completion took approximately 30 minutes. Following completion, a draw for 1 of 10 \$200 cash prizes occurred. Participants were also given a description of Phase 2 and were asked whether they were interested in participating in that phase.

Phase 2. In Phase 2, an e-mail invitation was sent to students who expressed interest in participating in this phase. In the first two weeks of October, students met individually on campus with the Research Assistant and were given a letter of information and a personal identification number. Then, they signed a consent form, and received a \$2 coffee shop coupon. Over 26 weeks, from October 2006 to April 2007, participants completed an online questionnaire based on the previous week's activities (Monday to Sunday). Questionnaires had to be completed by Tuesday at midnight, and each week, participants received two e-mail reminders. Questionnaire completion took approximately 15 minutes. At the end of each questionnaire, a list of resources was provided for those in distress, and a weekly draw for 1 of 3 \$50 cash prizes occurred. In addition, participants received a weekly compensation of \$5, paid in three installments.

Results

Descriptive Statistics

Academic Motivation as a Function of Time of Academic Year and Gender. The mean academic motivation per week in Phase 2 is presented in Figure 1. Three paired samples *t*-tests were conducted to assess changes in academic motivation at notable time points, such as December exams vs. Christmas break and Christmas break vs. the first week back to school in January. A decrease in academic motivation occurred from the end of December exams to the

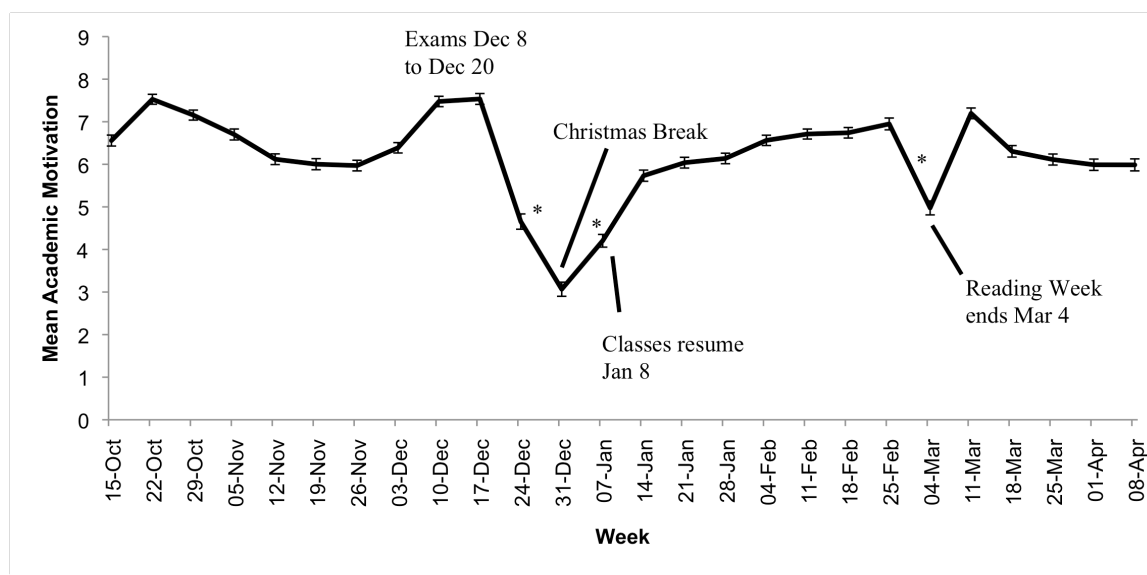


Figure 1. Academic motivation as a function of time of academic year. Asterisks (*) refer to significant adjacent week differences. Error bars represent SEM.

Christmas break, $t(254) = 20.571, p < .001$. An increase in academic motivation occurred from Christmas break to the first week of school in January, $t(262) = -14.530, p < .001$. A decrease in academic motivation occurred from the week before reading week to reading week, $t(242) = 9.253, p < .001$.

To determine whether males and females significantly differed in their academic motivation, an independent samples t -test was conducted. The Levene's test for equality of variances was not significant, meaning that equal variances were assumed, Levene $F(1,373) = 2.352, ns$. Males and females do not differ in their levels of academic motivation, $t(373) = .005, ns$.

Drinking as a Function of Time of Academic Year and Gender. Drinking as a function of time of academic year and gender will not be investigated in detail here, as Tremblay et al. (2010) previously examined these relationships. In general, males and females had similar

drinking behaviours, but males always drank more than females. Drinking was highest during Christmas break and lowest during December exams.

Weekly Correlations of Academic Motivation with Drinking. Correlations between drinking in the previous week, the current week, and the subsequent week for the 26 weeks in Phase 2 were examined (see Table 1). For the majority of weeks, a negative correlation between drinking and academic motivation was found. In week 12, which ended on December 31, drinking was negatively correlated with the current week's academic motivation, $r(287) = -.153$, $p < .01$, and with the subsequent week's academic motivation, $r(257) = -.182$, $p < .01$. So, during the two weeks of Christmas break, an increase in drinking was associated with a decrease in academic motivation. During December exams, no significant correlation was found between drinking and academic motivation. During week 21, reading week, drinking was also negatively correlated with the current week's academic motivation, $r(330) = -.123$, $p < .05$.

Mediation Analyses

It was hypothesized that HED leads to decreased academic motivation, subsequently leading to decreased grades. To test this hypothesis, a number of multiple regression analyses were conducted using the Baron and Kenny (1986) approach. Following this approach, a calculation to test for the significance of mediation was conducted (Preacher & Hayes, 2008). This test for mediation performs Bootstrapping, which provides more accurate standard errors by calculating bias corrected confidence intervals. Mediation analyses for mean number of drinks and HED are presented in Figure 3. To summarize, academic motivation mediates the drinking - achievement relationship for both mean number of drinks and HED when testing total participants. In other words, drinking leads to decreased academic motivation, subsequently leading to decreased grades. However, when testing academic motivation as a

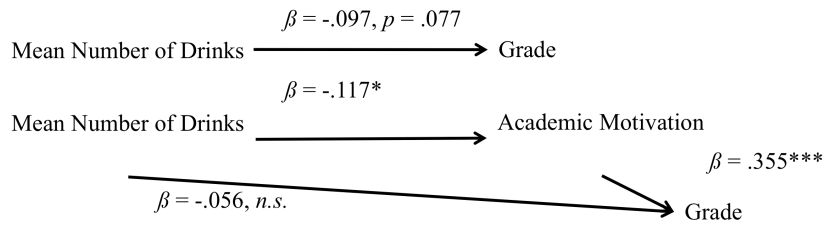
Table 1

Weekly Correlations of Academic Motivation with Drinking

Drinking	Previous Week	Current Week	Subsequent Week
Week 1	-	-0.218***	-0.051
Week 2	-0.076	-0.103*	-0.059
Week 3	-0.050	-0.080	-0.059
Week 4	-0.088	-0.099	-0.091
Week 5	-0.070	-0.142**	-0.151**
Week 6	-0.192***	-0.139**	-0.042
Week 7	-0.146**	-0.148**	-0.096
Week 8	-0.093	-0.095	0.034
Week 9	0.013	-0.174**	-0.115*
Week 10	-0.028	-0.083	-0.059
Week 11	-0.046	0.049	-0.124*
Week 12	0.052	-0.153**	-0.182**
Week 13	-0.156*	-0.077	-0.114*
Week 14	-0.109	-0.218***	-0.064
Week 15	-0.153**	-0.124*	-0.090
Week 16	-0.074	-0.185**	-0.074
Week 17	-0.134*	-0.191***	-0.018
Week 18	-0.016	0.021	0.069
Week 19	-0.013	-0.048	0.060
Week 20	-0.031	-0.031	0.032
Week 21	-0.067	-0.123*	-0.065
Week 22	-0.002	-0.071	-0.109
Week 23	-0.005	-0.109	-0.076
Week 24	-0.047	-0.161**	-0.090
Week 25	-0.044	-0.096	-0.087
Week 26	-0.047	-0.194**	-

Note. * = $p < .05$; ** = $p < .01$; *** = $p < .001$

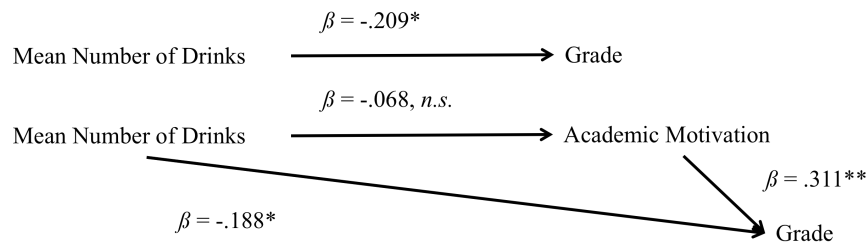
Total Mean Number of Drinks



Unstandardized indirect (mediated effect): $-.068^*$ ($-/+CI95\%: -.156, -.013$)
 Standardized indirect (mediated): $-.042$
 Standardized direct: $-.056$
 Standardized total: $-.097$

Note. $*$ = $p < .05$, $***$ = $p < .001$

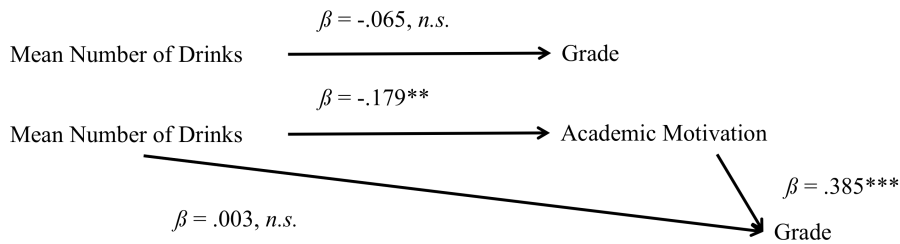
Male Mean Number of Drinks



Unstandardized indirect (mediated effect): $-.023$ ($-/+CI95\%: -.102, .029$)
 Standardized indirect (mediated): $-.021$
 Standardized direct: $-.188^*$
 Standardized total: $-.209^*$

Note. $*$ = $p < .05$, $**$ = $p < .01$

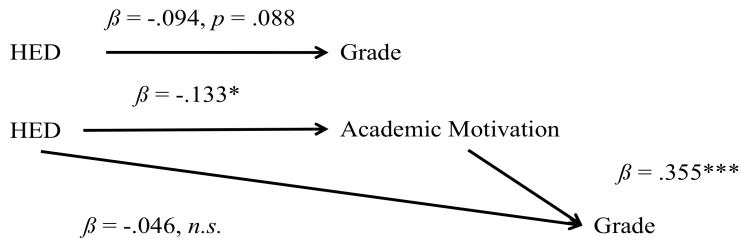
Female Mean Number of Drinks



Unstandardized indirect (mediated effect): $-.163^*$ ($-/+CI95\%: -.365, -.044$)
 Standardized indirect (mediated): $-.069$
 Standardized direct: $.003$
 Standardized total: $-.065$

Note. $**$ = $p < .01$, $***$ = $p < .001$

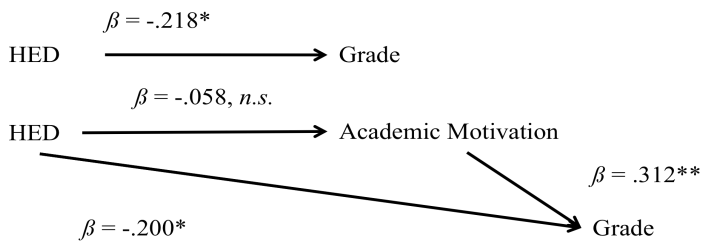
Total HED



Unstandardized indirect (mediated effect): -1.527* (-/+CI95%: -3.450, -.459)
 Standardized indirect (mediated): -.047
 Standardized direct: -.046
 Standardized total: -.094

Note. * = $p < .05$, *** = $p < .001$

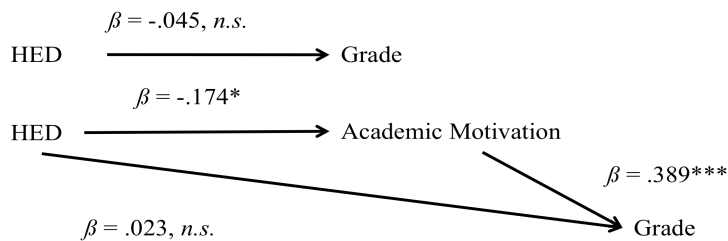
MALE HED



Unstandardized indirect (mediated effect): -.482 (-/+CI95%: -2.596, 1.234)
 Standardized indirect (mediated): -.018
 Standardized direct: -.200*
 Standardized total: -.218*

Note. * = $p < .05$, ** = $p < .01$

FEMALE HED



Unstandardized indirect (mediated effect): -2.353* (-/+CI95%: -5.584, -.585)
 Standardized indirect (mediated): -.068
 Standardized direct: .023
 Standardized total: -.045

Note. * = $p < .05$, *** = $p < .001$

Figure 3.

mediator separately for males and females, academic motivation serves as a mediator for females, but not males for both mean number of drinks and HED.

Drinking and Faculty Program

An exploratory analysis was conducted to determine whether drinking behaviours, measured as the mean number of drinks per week, were associated with faculty program. Data were analyzed using a 2x8 analysis of variance (ANOVA), with groups being gender (male or female) and faculty (arts and humanities, management and organizational studies, engineering, bachelor of health sciences, kinesiology, information and media studies, science and social science). No hypothesis was made. The Levene's test for equality of variances was significant, and equal variances were not assumed, Levene $F(15,360) = 4.573, p < .001$. Results should be interpreted cautiously. No interaction was found between gender and faculty, $F(7,360) = .571, ns$, meaning that the effect of gender on the mean number of drinks consumed did not vary with faculty. A significant effect of gender was found, $F(1,360) = 19.047, p < .001$, meaning that males and females differed in their drinking behaviours. A significant effect of faculty was found, $F(7,360) = 3.328, p < .01$, meaning that at least one faculty differed in their drinking behaviours. To determine which faculties differ in their drinking behaviours, a post-hoc test of Tukey's HSD was conducted. After controlling for gender, participants in engineering consumed a greater mean number of drinks per week ($M = 7.569, SE = 1.240$) than science ($M = 4.150, SE = .516$), and participants in social science consumed a greater mean number of drinks per week ($M = 7.730, SE = .680$) than science ($M = 4.150, SE = .516$). See Figure 4 for the mean and standard error for each faculty. The faculties of nursing, music, and other were not included in the analyses.

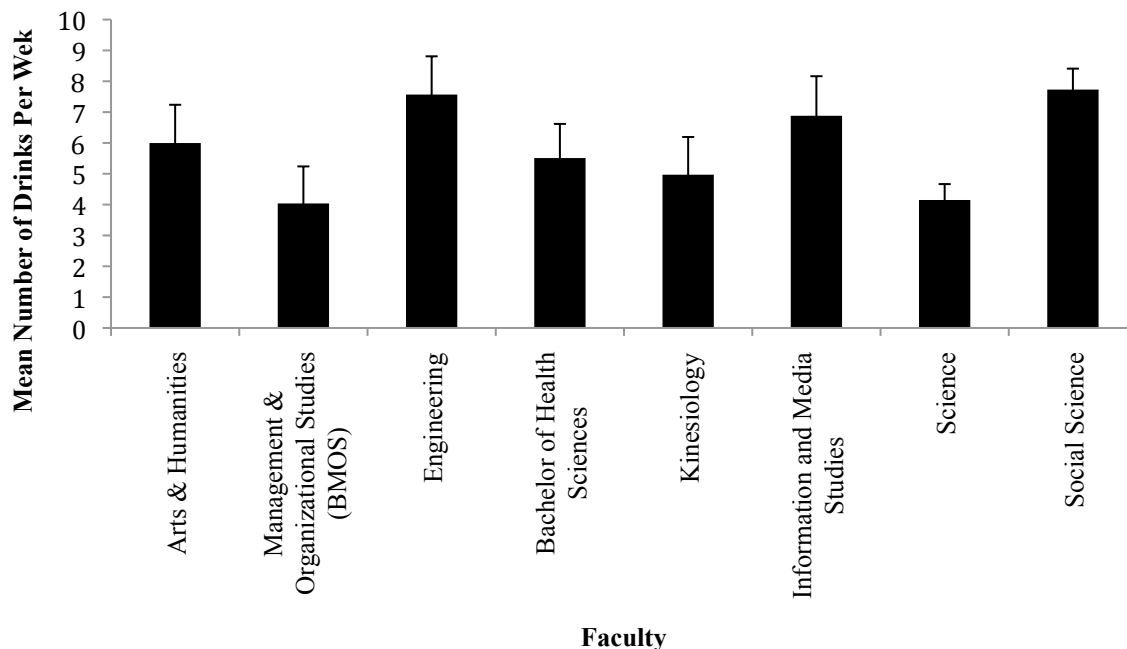


Figure 4. Mean number of drinks per week per faculty, controlling for Gender. Error bars represent SEM.

Academic Motivation and Faculty Program

An exploratory analysis was also conducted to determine whether academic motivation was associated with faculty. Data were analyzed using a 2x8 ANOVA, with groups being gender (male or female) and faculty (arts and humanities, management and organizational studies, engineering, bachelor of health sciences, kinesiology, information and media studies, science and social science). No hypothesis was made. The Levene's test for equality of variances was not significant, $F(15,328) = .742$, *ns*. No interaction was found between gender and faculty, $F(7,328) = .829$, *ns*, meaning that the effect of gender on academic motivation did not vary with faculty. No effect of gender was found, $F(1,7) = .000$, *ns*, meaning that males and females did not differ in their levels of academic motivation. A significant effect of faculty was found, $F(7,328) = .829$, $p < .05$, meaning that at least one faculty differed in their academic motivation. To determine which faculties differed in their drinking behaviours, a post-hoc test of

Tukey's HSD was conducted. After controlling for gender, participants in the bachelor of health sciences had greater academic motivation ($M = 6.768$, $SE = .280$) than social science ($M = 5.719$, $SE = .178$). The faculties of nursing, music, and other were not included in the analyses.

Discussion

The results support the main hypothesis that academic motivation mediates the drinking - achievement relationship for both mean number of drinks and HED for males and females combined, and for females only. Students who drink tend to have decreased academic motivation, which is associated with lowered grades. However, the secondary gender analyses were not supported. It was hypothesized that academic motivation would act as a mediator for both males and females, with a stronger effect on males. The present study found mediation to be supported for females only. In females, the drinking-achievement relationship is mediated by academic motivation, but in males, academic motivation does not mediate this relationship for mean number of drinks or HED. For males, there remains a direct negative association between drinking and grades.

It must be noted that the Baron and Kenny (1986) approach would not support the present study's results of significant mediation. In that approach, the first step of testing whether drinking has a significant effect on grade has to be satisfied to be considered mediation. Some researchers have debated about whether the link between the predictor and the outcome, in this case, the link between drinking and grades, without the mediator needs to be significant to show mediation. More recently, Mackinnon, Fairchild, and Fritz (2007) have argued that a significant indirect/mediated effect can occur. In the present study, only the male analyses showed a significant link between drinking and grades.

These findings connect past research that shows an association between HED and academic achievement (Pascarella et al., 2007; Singleton, 2007; DeBerard et al., 2004; Porter & Pryor, 2007), drinking and academic motivation (Rhoades & Maggs, 2006; Wechsler et al., 1995; Simons, Christopher, & Mclaury, 2004; Wolaver, 2002), and academic motivation and academic achievement (Svanum & Bigatti, 2006; Rau & Durand, 2000). The connection is that, in general, drinking is associated with decreased academic motivation, which is subsequently associated with decreased academic achievement.

The gender differences in mediation may be due to a number of reasons. First, a greater number of females participated in the study. This larger female sample size provides more statistical power to detect effects.

Second, when focusing on the association between drinking and motivation, the present study found that for men, no significant association was found between drinking and academic motivation; however, the present study did find significant associations between drinking and academic motivation for women. These findings are contradictory to a number of past studies. Webb et al. (2007) and Li et al. (2013) found drinking to be associated with decreased academic motivation for men, and no correlation between the two for women. In the present study, it is possible that the males who participated normally drink less than the males who did not participate. In fact, Tremblay et al. (2010) noted that Phase 2 participants differed from those who participated in Phase 1 only and may have drunk less than Phase 1 participants. In this case, the marginal levels of alcohol consumed may not have been enough to affect their levels of academic motivation. Also, considering that Phase 2 participants may drink less than other students, the variability in drinking and academic motivation may be reduced, resulting in potentially attenuated estimates of the effects.

Not all past studies contradict the present study's gender difference findings. Interestingly, Vaughan et al. (2009) found an association between drinking and academic motivation for women, but their findings were presented in terms of the influence of academic motivation on levels of drinking in women. They found that women who were academically motivated drank less, so academic motivation served as a protective factor against drinking for women. Men who were academically motivated still drank. The multiple regression analyses in the present study can also be interpreted in this way, as they are correlational, not causal. It is unknown whether increased drinking results in decreased academic motivation, or whether increased academic motivation results in decreased drinking.

Perhaps the differences in findings between Webb et al. (2007) and Li et al. (2013) and Vaughan et al. (2009) and the present study results from differences in methodology. Webb et al. (2007) and Li et al. (2013) administered one-time questionnaires to students that asked about their frequency of drinking in the past month. They did not ask participants to list the number of drinks they consumed on each day of the past month. Both the study by Vaughan et al. (2009) and the present study were longitudinal, and more precise measures of alcohol consumption were obtained. Both studies asked participants to list the number of drinks consumed on each day of the week for the duration of the survey period. The present study collected weekly data over 26 weeks, and the average of that data was used for analysis. Data collected from a one-time assessment at the beginning of a semester may differ from data collected during December exams. Collecting data over a long time period is more beneficial, especially since the drinking trajectory changes over the academic year (Tremblay et al., 2010). The present study's findings match those of Vaughan et al. (2009), and because of the similar methodology and support of this past research, we can be confident in our methods.

Perhaps gender differences occurred because of a hormonal difference between men and women in relation to drinking and academic motivation. Men and women have different hormone levels that can affect their behaviours in different ways in the same environment. Dotson, Robertson, and Tuchfeld (1975) found changes in testosterone levels in male university students to be significantly associated to their plasma alcohol concentrations. Females were not tested in the study. Hormones can play a role in one's ability to successfully complete academic tasks, and people who can adjust their behaviour to meet a task's demands have greater resiliency, as shown by higher dehydroepiandrosterone (DHEA) than cortisol levels (Wemm, Koone, Blough, Mewaldt, & Bardi, 2010). Perhaps men have a hormone that allows them to be more resilient after a night of drinking, so that their academic motivation is not affected in the same way as for women. Or, perhaps women have a lack of a hormone so they do not bounce back after a night of drinking. Maybe they take longer to return to a homeostatic state than men, and cannot put as much effort into their studies until their body returns to homeostasis.

The weekly academic motivation graph showed a trajectory similar to what was expected. As previously mentioned, academic motivation was highest during December exams, significantly declined from December exams to the Christmas break, and significantly increased from the Christmas break to the first week of the semester in January. Academic motivation also significantly declined at reading week. Also as expected, the trajectory of academic motivation had an opposite pattern to the trajectory of weekly drinking. For example, high instances of drinking occurred on New Year's Eve (Tremblay et al., 2010), whereas low instances of academic motivation occurred on Christmas break, and low instances of drinking occurred during December exams, whereas high instances of academic motivation occurred during that

time period. Also, as expected, males and females did not differ in their levels of academic motivation.

Students in different faculties differed in their levels of drinking and academic motivation. Both the engineering and social science faculties drank more than the faculty of science. The differences in drinking between faculties could be a result of many factors that can be studied in the future. Perhaps there are cultural differences between faculties. For instance, for engineering students, it is possible that because they take more courses each semester than other faculties, they have a motto to “work hard and play hard”, or, it is possible that their future success hinges on their ability to network in informal social settings where drinking occurs. Another explanation could be that students in engineering and social science drink more because it is their way of coping with stress from their program’s academic demands.

Students in the faculty of health sciences had greater academic motivation than students in social sciences. The possibility exists that because students in social sciences consumed a greater mean number of drinks than students in health sciences, that they had decreased academic motivation. This explanation is consistent with the present study’s findings that drinking is associated with decreased academic motivation. Future studies can determine whether there are achievement differences between faculties, and whether academic motivation acts as a mediator of the drinking - achievement relationship between faculties.

Limitations

A limitation that may explain why overall mediation was supported is that more females than males completed the weekly surveys. It seems as though females had a greater influence in driving the overall mediation analyses. Perhaps females are more conscientious and aware of the

impact drinking has on their academic motivation and achievement. If an even gender distribution in participants existed, perhaps the results would have been different.

Another limitation also relates to the participants who completed the survey. From an initial invitation to 4884 students, only 415 chose to participate in Phase 2. Perhaps these students, consciously choosing to continue contributing to the university's research, are conscientious students who focus more on their schoolwork and do not drink as much or as often as students who chose not to participate in the study. So, a sample selection bias may have occurred. This is particularly interesting, considering that the World Health Organization's Alcohol Use Disorders Identification Test Screener identified that almost 33% of Canadian students engage in HED (Adlaf et al., 2005), and the present study identified 34.29% of students who engage in HED. These numbers seem low and may not capture the true nature of drinking behaviours in university students. Or, perhaps a self-report bias occurred, and participants underreported their drinking behaviours. Most studies that collect data on drinking behaviours use self-report measures. Additional measures of drinking behaviours may provide more accurate data.

Another limitation that may have affected the study's results involves the academic motivation measure. Only one question was used to measure academic motivation. Participants may have over-reported their academic motivation to appear socially desirable. Also, the reliability of the question has not been formally tested to ensure that it actually measures academic motivation.

Future Directions

Since academic motivation did not mediate the drinking - achievement relationship for men, other mediation variables could be tested to determine what explains the occurrence of this

relationship in men. The questionnaire administered to students by Tremblay et al. (2010) also asked students about their depressive symptoms. Perhaps after drinking, men experience depressive symptoms, subsequently leading to decreased grades. Drinking and depressive symptoms have been shown to be positively associated (Gonzalez, Reynolds, & Skewes, 2011), and depression and grades have been shown to be negatively associated (Haines, Norris, & Kashy, 1996). Mediation analyses can be conducted to determine whether depressive symptoms mediate the drinking - achievement relationship in men.

Weekly correlations of academic motivation with drinking were calculated in the present study to determine whether patterns existed from one week to the next. Although the majority of correlations supported findings that a negative relationship exists between drinking and academic motivation, more complex analyses can be conducted that are beyond the scope of this study. Researchers can examine mediation in a longitudinal context. By doing this, they can determine whether drinking at one time point is associated with academic motivation at a subsequent time point.

It is important to note that currently, there are fewer males than females in university. This might explain why more females than males participated in the study. It would be interesting to test males who did not attend university, but who are the same age as first-year students to see whether the drinking - achievement relationship exists for them, and whether motivation mediates that relationship. Achievement and motivation would have to be redefined to fit the context for these participants, but it would be a compelling study to further the understanding of the effects of drinking on young adults.

Another interesting direction for future studies could be to test whether drinking acts as a mediator for the motivation - achievement relationship. As Vaughan et al. (2009) explained,

academic motivation serves as a protective factor against drinking for women, but not for men. So, the possibility exists that decreased academic motivation leads to decreased grades in men and women because of their drinking behaviours.

To conclude, students who drink tend to have decreased academic motivation, which is associated with lowered grades. Academic achievement is important for success in post-undergraduate life, but drinking behaviours can impair achievement. Most students are aware that drinking leads to decreased achievement, so prevention programs implemented in university can focus on maintaining and increasing academic motivation, rather than teaching the negative effects of drinking. This way, students will be informed about how they can maximize their academic success!

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Appendix A

Paul F. Tremblay

APPENDIX

PHASES 2 & 3: WEEKLY AND MONTHLY QUESTIONNAIRES

I. Alcohol, Smoking, Medication, Sports and Fitness

The following items refer to your alcohol consumption in the past week (Monday to Sunday).

An “alcoholic drink” refers to:

- one 341 ml (12 ounce) bottle or glass of beer (regular strength 5% alc)
- one 150 ml (5 ounce) glass of wine
- one mixed drink with 45 ml (1.5 ounces) of spirits (e.g., vodka, rye, rum, scotch, gin)
- one 341 ml (12 ounce) alcohol cooler, wine cooler, or premixed drink (e.g., Mike’s Hard Lemonade, Smirnoff Ice, Bacardi Silver, Bacardi Breezer, Long Island Iced Tea, Vibe and so on)

Do not include beer or other alcoholic drinks with ½ % or less alcoholic content.

1. During the past week (Monday to Sunday), not counting today, did you have any alcoholic drinks?
 - Yes
 - No (if you answered “No”, please skip to Question #5)

2. Please estimate the number of alcoholic drinks that you had on each day during the past week (Monday to Sunday). Write in the number of drinks for each day directly in the table below.

Past Week (Monday to Sunday) Number of Alcoholic Drinks	Mon	Tue	Wed	Thu	Fri	Sat	Sun
a. Number of regular size (12 oz.) bottles/glasses of light (less than 5%) beer	_____	_____	_____	_____	_____	_____	_____
b. Number of regular size (12 oz.) bottles/glasses of regular (5%) beer	_____	_____	_____	_____	_____	_____	_____
c. Number of regular size (12 oz.) bottles/glasses of strong (greater than 5%) beer	_____	_____	_____	_____	_____	_____	_____
d. Other amounts/types of beer. Please specify _____	_____	_____	_____	_____	_____	_____	_____
e. Number of regular glasses of wine (150 ml or 5 oz)	_____	_____	_____	_____	_____	_____	_____
f. Number of drinks of regular size (1.5 oz) shots of spirits (i.e., hard liquor, mixed drinks, cocktails)	_____	_____	_____	_____	_____	_____	_____
g. Liquor and wine coolers, please specify name: _____	_____	_____	_____	_____	_____	_____	_____
h. Other. Please specify type and amount of alcohol: _____	_____	_____	_____	_____	_____	_____	_____

3. Last week, on the days that you drank, where did your drinking occur? You may select more than one location for a given day.

