

THE ACADEMIC OPPORTUNITY COSTS OF SUBSTANCE USE DURING COLLEGE

*A Brief Report from the
Center on Young Adult Health and Development*

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May 2013

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About the Center on Young Adult Health and Development

The Center on Young Adult Health and Development (CYAHD) was established at the University of Maryland School of Public Health in 2009. This research center is one of the first such centers in the United States specifically dedicated to understanding the health and development of young adults. More information about CYAHD can be found at www.cyahd.umd.edu.

Suggested Citation

Arria, A. M., Caldeira, K. M., Bugbee, B. A., Vincent, K. B., & O'Grady, K. E. (2013). *The academic opportunity costs of substance use during college*. College Park, MD: Center on Young Adult Health and Development. Available at www.cls.umd.edu/docs/AcadOppCosts.pdf.

Acknowledgements

This brief report was supported by the National Institute on Drug Abuse (R01-DA014845).

Special thanks are extended to John Carnevale, Ph.D., Robert L. DuPont, M.D., Helen DuPont, M.B.A., David H. Jernigan, Ph.D., and Corinne Shea, M.A. for their thoughtful critiques of this report.

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Introduction

Most people recognize the devastating toll alcohol poisonings and drug-related violence exact on college campuses. The more subtle academic costs of college drinking and drug use might be less noticeable—but can have long-term impacts on student success. National statistics paint a troubling picture of our nation’s college graduation rates, with 56% of male and 61% of female first-time, full-time students who sought a bachelor’s degree at a four-year college in fall 2004 completing their degree at that college within six years.¹

To remain globally competitive in today’s knowledge-based economy, colleges are placing a high priority on improving their graduation rates. While many factors are in play, this report sharpens the focus on how substance use and mental health problems might contribute to what we call a “cascade of academic problems”, starting with missing class, through failing grades, to dropping out.

Another related issue is that even among college students who graduate, finding a job after college is not always easy. Many graduates report getting jobs after college that don’t require a college degree,² and they are beginning to wonder whether the time and money they spent on college was even worth it. Colleges and parents should promote the message that excessive drinking and substance use can interfere with acquisition of skills and experiences needed to be competitive in today’s job market.

College can and should be one of the most rewarding and memorable periods in the lives of those who are fortunate enough to have the chance to experience it. But substance use has an insidious way of interfering with a student’s ability to take advantage of all that college has to offer. The time has come to shift our thinking away from the normalcy of partying during college toward finding solutions to reduce rates of substance use to promote students’ long-term success and well-being.

This report sheds light on the research linking excessive alcohol and drug use during college to academic performance. By interfering with the achievement of educational goals, substance use can be viewed as having “academic opportunity costs”, which ultimately can undermine a student’s ability to fulfill his/her individual potential. In sum, although partying might be emblematic of college life, it comes with a price.

Substance use has an insidious way of interfering with a student’s ability to take advantage of all that college has to offer. Interventions to reduce rates of substance use should be part of any college’s plan to improve student retention.

op·por·tu·ni·ty cost:
what a person sacrifices when they choose one option over another

Key Research Findings

- **Alcohol and drug use are prevalent among college students.** On average, 40% of college students drink alcohol excessively, with little change in trends during the last decade,³ 16% meet criteria for an alcohol use disorder, and 22% used a drug during the past month, with marijuana being the most common.⁴ Nonmedical use of prescription medications can also be a serious problem, but this use varies significantly across colleges.^{5,6} Moreover, excessive drinking and drug use often overlap.⁷
- **Excessive drinking and drug use are both associated with short-term academic problems.** Students who use substances during college spend less time studying and skip more classes,⁸⁻¹¹ thereby reducing their exposure to the classroom learning environment and the beneficial experience of interacting with faculty and other students.
- **Excessive drinking and drug use can interfere with college degree completion.** Longitudinal research has found that students who use alcohol and drugs are more likely to have disruptions in their enrollment in college and also fail to graduate.^{12,13} Associated mental health problems can exacerbate the adverse academic consequences of excessive drinking and drug use.¹⁴
- **Neurobiological research has identified mechanisms by which excessive drinking and drug use might interfere with academic performance.** New neurobiological research shows that substance use “hijacks” reward pathways in the brain.^{15,16} Over time, the rewards of academic achievement can be replaced with the temporary rewards of intoxication and getting high. The end result is decreased motivation to pursue academic goals and disengagement from college.
- **Reducing excessive drinking and drug use is a viable strategy for improving academic performance and retention.** The relationship between excessive drinking, drug use, and academic performance and retention in college is rarely acknowledged in educational circles. Interventions to reduce the rates of excessive drinking and drug use among America’s college students could have profound impacts on college retention and could positively impact the long-term success and employability of college graduates.

Reducing the rates of excessive drinking and drug use among college students could have profound impacts on student retention and could positively impact their long-term success and employability.

Just how much are we investing in college students?

In 2010, there were roughly 21 million college students in the United States,¹ and the average annual cost of attending college was \$21,889.¹⁷ Most of this cost was paid by families (26% by students, 37% by parents), but 33% was provided by scholarships, grants, and other forms of financial aid.¹⁷

The 2013 budget for the Department of Education includes \$165 billion for federal grants, loans, and work study, an increase of 69% from the 2008 budget.¹⁸ In 2013, the American Opportunity Tax Credit will provide approximately \$19.1 billion in tax breaks for students and their families.¹⁸ The Department of Veterans Affairs spent an additional \$11 billion on educational benefits to Veterans, reservists, and active duty personnel in 2012 through the GI Bill and other programs.¹⁹

Promoting College Student Success: What is at Stake?

The personal investments made by students and families leading up to college matriculation are enormous. Moreover, there is no question that financial investments in higher education are significant for taxpayers. For the individual student, a college degree translates to greater opportunities and earning potential over their lifetime.²⁰ For society, a well-educated workforce enhances the growth and stability of the entire economy, with attendant benefits in terms of global competitiveness and general welfare.

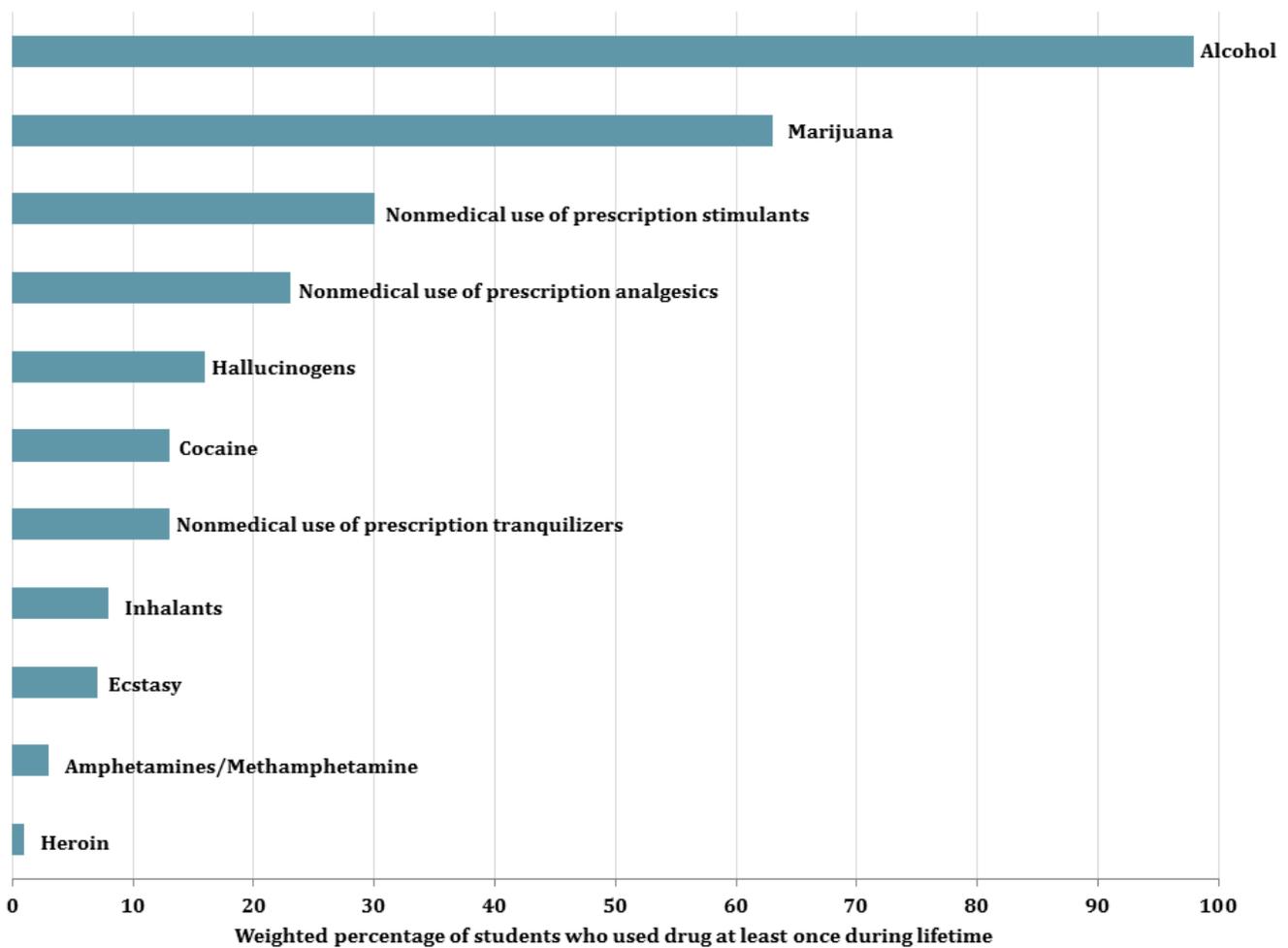
Unfortunately, too many college students in the U.S. are underperforming or failing to graduate. About half of students enrolled in a four-year college graduate within six years of entry to that college, and trends have not changed substantially during the last two decades.^{1,21} Those who do graduate often do so without having mastered the skills employers demand.²²

Prevalence of Alcohol and Drug Use During College

Alcohol and drug use are highly prevalent among college students. Forty percent of U.S. college students have had five or more drinks in a row during the past two weeks, with little change in trends during the last decade,³ and 16% meet criteria for an alcohol use disorder.⁴ Nationally, 22% are current drug users, with marijuana being the most common drug used.⁴ For some students, use is far from being isolated occasions of “experimentation”, with many developing alcohol and drug use patterns that are severe enough to be clinically significant. In one large study, one in four marijuana-using students met criteria for dependence.²³ Students who use drugs—either illicit drugs or prescription drugs used nonmedically—are often the same students who drink heavily. In fact, drug use typically signifies a higher level of alcohol involvement, and on average, the heavier the alcohol use, the heavier the drug use.^{7,24}

Nationally, 58% of students who attend a four-year college complete a degree there within six years. Trends indicate little sign of improvement.^{1,21} Moreover, many college graduates have not mastered the skills employers demand.²²

Figure 1. Prevalence of alcohol and drug use by the fourth year of college



Source: College Life Study, unpublished data. See the following papers for more information: Arria AM, Caldeira KM, O'Grady KE, Vincent KB, Fitzelle DB, Johnson EP, Wish ED. Drug exposure opportunities and use patterns among college students: Results of a longitudinal prospective cohort study. *Subst Abus.* 2008;29(4):19-38. Vincent KB, Kasperski SJ, Caldeira KM, Garnier-Dykstra LM, Pinchevsky GM, O'Grady KE, Arria AM. Maintaining superior follow-up rates in a longitudinal study: Experiences from the College Life Study. *Int J Mult Res Approach.* 2012;6(1):56-72.

Problems Often Begin During High School

Alcohol use among college students typically begins long before college entry. Students who drink alcohol during high school are likely to continue their drinking patterns when they enter college,²⁵ and research shows that their frequency of excessive drinking sometimes escalates.²⁶ High school seniors with plans to go to college are less likely to have used marijuana than students with no college plans (35% vs. 42%),²⁷ but after starting college, opportunities to use drugs are common. One study found that while 38% of college students had tried marijuana before coming to college, an additional 25% began using marijuana for the first time after starting college.²⁸

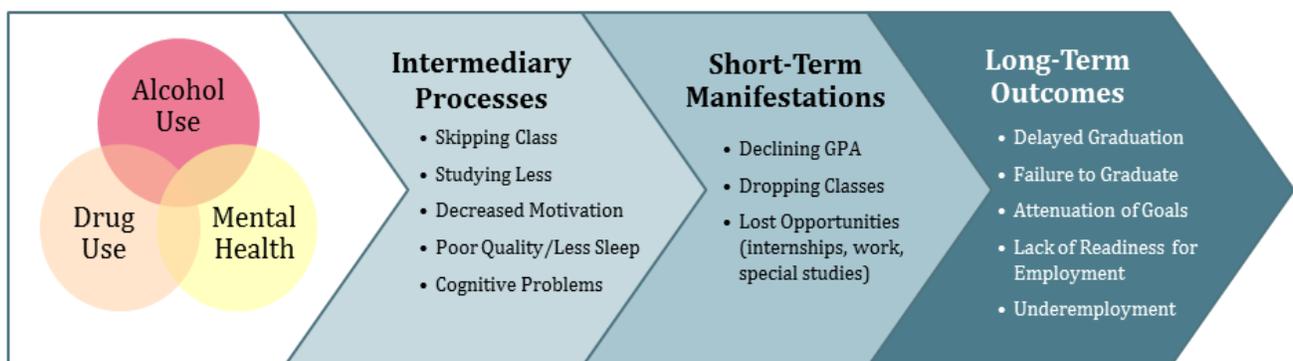
During adolescence, excessive drinking and drug use can affect academic performance in at least two major ways.¹⁶ First, the use of alcohol and drugs during early adolescence adversely affects brain

development (see below, *Neurobiological Consequences of Substance Use*), potentially interfering with a student’s motivation and ability to learn. Second, high school students who use alcohol or drugs often affiliate with peers who tend to reject conventional norms—such as a respect for authority and a belief in the value of academic pursuits. Although it is common for early conduct problems to be present even before alcohol or drug use begins, substance use can perpetuate the student’s involvement in a variety of problem behaviors and can further their alienation from both school and their parents.

Excessive Alcohol Use and/or Drug Use During College Contributes to a Cascade of Adverse Consequences

Several research studies have shed light on the relationship between substance use during college and academic performance and retention. The effects of excessive drinking and/or drug use during college can be understood as a “cascade” of interrelated problems that accumulate over time (see Figure 2). Students who drink excessively tend to spend less time studying^{8,10} and skip more of their classes.¹¹ As with excessive drinking, drug use—especially marijuana use—appears to contribute to college students skipping more classes, spending less time studying, earning lower grades, dropping out of college, and being unemployed after college.^{8,9,11,12,29-33} In fact, the cascade of consequences is similar regardless of whether students are drinking excessively, using drugs, or nonmedically using prescription drugs. For example, one study showed that college students who nonmedically used prescription stimulants and analgesics skipped 21% of their classes, whereas non-users skipped only 9% of their classes.⁹ Another study found that the more drinks a student consumed per drinking occasion, the less time they spent studying, which led to predictable negative effects on their GPA.¹⁰ Accordingly, drug use and excessive drinking also set the stage for disruptions in college enrollment, or “stopping out” from college^{12,32} (see Box 1). Ultimately, this trajectory can lead to a greater likelihood of delayed graduation or a failure to graduate.³⁴ The cascade of consequences even extends beyond college graduation in the form of poorer employment outcomes and lower lifetime earnings.^{8,20,31,35}

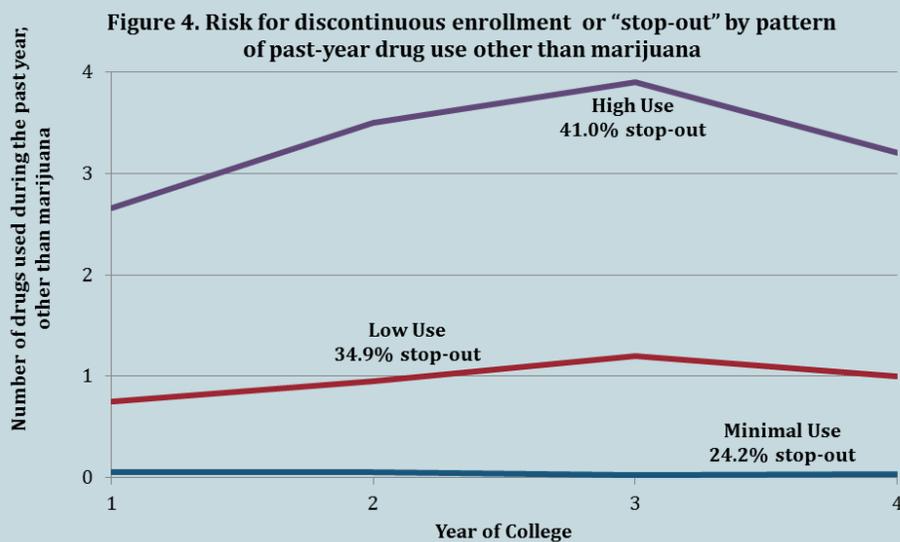
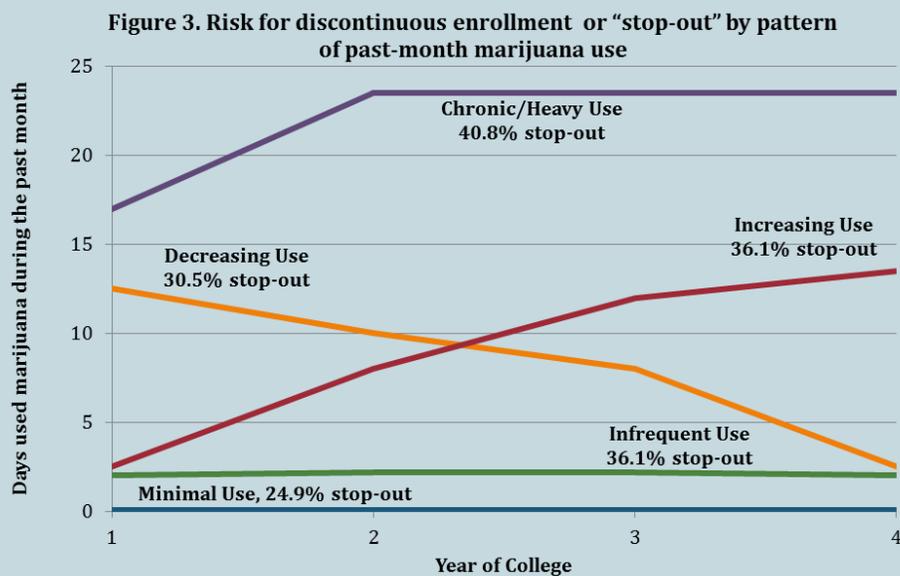
Figure 2. Alcohol use, drug use, and mental health outcomes have a cascade of effects on college students’ academic outcomes



Box 1. Drug Users Have Increased Risk for Discontinuous Enrollment

Students ($N=1,133$) at one large university were categorized into groups according to their longitudinal patterns of drug use during four years of college. Two sets of trajectory groups were created: 1) based on how often they used marijuana each year, and 2) based on how many drugs other than marijuana that they used each year.

Both marijuana (Figure 3) and drug use other than marijuana (Figure 4) were significantly related to higher chances of discontinuous enrollment (i.e., not being enrolled for one or more semesters) or “stop-out”, sometime during the first four years of college, even after controlling for the effects of demographics, high school GPA, and personality variables. For example, students who used marijuana very frequently all four years (i.e., “Chronic/Heavy” users) were twice as likely as “Minimal” users to experience discontinuous enrollment. Even “Infrequent” marijuana users were 66% more likely than Minimal users to be discontinuously enrolled.



Source: Arria AM, Garnier-Dykstra LM, Caldeira KM, Vincent KB, Winick ER, O’Grady KE. Drug use patterns and continuous enrollment in college: Results from a longitudinal study. *J Stud Alcohol Drugs*. 2013;74(1):71-83.

Some of the other intermediary processes influencing academic outcomes supported by empirical research are alcohol-related changes in cognitive functioning and sleep problems. Specifically, excessive drinking is known to cause problems with short-term memory and other brain functions,³⁶ which in turn can undermine the efficiency and effectiveness of study time. It has also been observed that alcohol-related differences in sleep patterns contribute to greater daytime sleepiness and, consequently, lower grades.³⁷ Finally, although it is hard to account for differences in the difficulty of certain majors, there is some evidence that heavy drinkers gravitate toward less demanding majors.^{8,38} For example, in one study heavy drinkers were more likely than their counterparts to choose a social science or business major and less likely to choose education, engineering, or the natural sciences.⁸

It is important to acknowledge that there are numerous challenges to overcome in this line of research, and findings have sometimes been mixed. Researchers have measured alcohol involvement in many different ways, and whereas students with greater severity of alcohol problems are more likely to have poorer academic outcomes, more moderate measures of alcohol use are not correlated as strongly with academic problems. There are many confounding factors that are related to both academic performance and heavy drinking, such as having an extraverted personality and being more engaged with campus life.^{13,39-41} Once these factors are taken into account, the association between heavy drinking and attrition from college becomes more readily apparent.¹³ For example, it might seem paradoxical that students who are highly engaged in campus life—meaning they attend more parties, concerts, and sporting events—are both more likely to stay enrolled in college and tend to get drunk more often, as compared to their less “engaged” counterparts. Because of this paradox, heavy drinking might appear to have no bearing on a student’s likelihood of staying enrolled, but by using statistical methods that take into account the relationship between heavy drinking and event attendance, we can see that heavy drinking in fact strongly predicts a lower likelihood of re-enrolling the following semester.¹³

Neurobiological Consequences of Substance Use

Exposure to alcohol and drugs, especially during the vulnerable period of adolescent development as mentioned earlier, can lead to acute cognitive problems such as difficulty concentrating and sleep disturbances.^{36,37,42-44} These cognitive problems no doubt make it more difficult to function academically. Recent research has identified areas of the brain involved in learning and memory that are adversely affected by alcohol consumption.⁴⁵ Heavy alcohol consumption during adolescence has been shown to be associated with structural and functional changes during brain development that can manifest as poor planning, impaired executive functioning, and spatial and attention deficits.⁴⁶

Extensive research has documented the cognitive effects of marijuana use.^{42,47-50} Deficits are more likely when use is initiated earlier in life and when use is more frequent.⁵¹⁻⁵³ While acute effects of marijuana intoxication are well recognized and include numerous attention and concentration difficulties, as well as decreased working memory, decision response speed, and information processing,^{54,55} longer-term problems have been demonstrated as well.^{56,57} Neuropsychological deficits

include impaired planning, organizing, and problem solving. Research studies have also shown longer-term residual deficits related to the allocation of attentional resources, filtering out irrelevant material, and retrieval and immediate verbal memory deficits related to substance use,^{58,59} all of which are necessary for performing well inside and outside of the classroom. Importantly, these problems have been observed even after statistically adjusting for baseline intellectual ability.⁵⁸ Early chronic marijuana use has been linked to declines in IQ of up to 8 points,⁶⁰ which for a person with an average IQ corresponds to a drop from the 50th percentile to the 30th percentile.⁶¹

Mental Health is also an Important Part of the Picture

A more complete understanding of the relationship between substance use and academic outcomes must also take into account mental health problems, which often co-exist with substance use^{62,63}—and can have similar adverse impacts on academic performance. Research shows a strong association between early and chronic marijuana use and mental health problems such as depression, anxiety, and early onset and worsening symptoms of psychosis.⁶⁴⁻⁶⁹

Many students meet criteria for psychiatric disorders—such as depression, bipolar, or anxiety disorders⁷⁰—and nearly half say that their mental health affected their academic performance during the past month.⁷¹ In general, the presence of a psychiatric disorder makes a student significantly less likely to complete college, especially when those disorders are diagnosed during college.^{29,30,32,72} For first-year students in particular, the ability to persist into the second year of college is a critically important milestone—one that becomes more unlikely when they experience more depression, anxiety, and stress.^{32,73} Even when students are able to persist in college, their grades are likely to suffer in proportion to their mental health symptoms.⁷⁴

For first-year students in particular, the ability to persist into the second year of college is a critically important milestone—one that becomes less likely when they experience more depression, anxiety, and stress.

Because of the way that excessive drinking, drug use, and mental health problems tend to cluster together among the same students, it is important to recognize that their effects on academic outcomes do not overlap completely. In fact, all three problems appear to have separate, additive effects on some outcomes (e.g., discontinuous enrollment³²). It is also not surprising that they interact in complex ways to influence academic performance. For example, the academic consequences of drinking—such as falling behind on work and missing class—can be more pronounced when the drinker also has mental health problems.¹⁴

Improved Academic Outcomes are Likely to Result from Effective Substance Use and Mental Health Interventions

A full discussion of the interventions available to address these issues is beyond the scope of this report. However, campus leaders who are ready to confront these issues do have a range of effective options at their disposal.⁷⁵⁻⁷⁸ Research has shown that, for high school students, interventions that succeed in curbing drinking are likely to lead to improved class attendance in the short run.⁷⁹ College students are likely to experience similar benefits, thereby improving their grades and graduation rates in the long run. Motivational interviewing, during which feedback on alcohol consumption is provided by a counselor in a non-confrontational manner, has been shown to be effective at reducing alcohol use among college students.⁸⁰⁻⁸² This type of intervention can assist the student in identifying discrepancies between values or goals, such as academic success, and his/her drinking behavior,⁸³ and could be done in a variety of settings on campus, including health centers, counseling centers, or academic assistance centers. Computer-delivered interventions can also be used to assess alcohol consumption and provide personalized feedback to students.⁸⁴ In response to academic failure, rather than simply requiring students to stay out of school for a semester, administrators can engage students in personalized interventions to help students address any underlying problems with substance use, mental health, or other personal issues. This type of approach shows promise for improving their chances of persisting and eventually completing college.⁸⁵

Interventions in the larger environment on- and off-campus can also help to curb excessive alcohol use among college students. Evidence-based strategies include campus-community partnerships, publicizing and enforcing underage-drinking laws and zero tolerance laws for drivers under 21, reducing youth access to alcohol, decreasing the density of alcohol outlets near the campus, and increasing the price of alcohol around college campuses.⁸⁶⁻⁹⁰ An environment that is less supportive of excessive drinking and more

“In addition to reducing other adverse outcomes associated with drinking...policies to reduce college students' drinking can be expected to improve the quality of human capital they accumulate. The immediate benefits of this include reducing the likelihood of students dropping out of college because of poor grades and improving the likelihood of entrance into graduate programs (which is based largely on college GPA). The long-term consequences of improved academic performance include greater labor market participation and higher earnings.”¹⁰

conducive to student success can be established by combining strong leadership from college administrators and an involved and informed community to implement a comprehensive program of evidence-based strategies.⁸⁷

Summary

Excessive drinking and drug use remain significant problems on many college campuses. Contrary to the popular perception that substance use is a “normal” rite of passage endemic to the college experience, the more likely scenario—according to research evidence—is that it undermines students’ ability to succeed academically. Given the new research evidence, it behooves college leaders to recognize the connection between alcohol and drug use and academic retention, readiness and motivation to succeed, and view substance use prevention and intervention as a viable strategy to promote student success. More attention should be focused on identifying existing successful intervention models and designing innovative comprehensive approaches to promote student success.

References Cited

1. Snyder TD, Dillow SA. *Digest of education statistics 2011*. Washington, DC: National Center for Education Statistics; 2012.
2. Accenture. *Accenture 2013 college graduate employment survey: Key findings*. Chicago, IL: Accenture; 2013.
3. Johnston LD, O'Malley PM, Bachman JG, Schulenberg JE. *Monitoring the Future: National survey results on drug use, 1975-2011. Volume II: College students and adults ages 19-50*. Ann Arbor, MI: Institute for Social Research, The University of Michigan; 2012.
4. Substance Abuse and Mental Health Services Administration. *Results from the 2011 National Survey on Drug Use and Health: Detailed tables*. Rockville, MD: United States Department of Health and Human Services, Office of Applied Studies; 2012.
5. McCabe SE, Teter CJ, Boyd CJ, Knight JR, Wechsler H. Nonmedical use of prescription opioids among U.S. college students: Prevalence and correlates from a national survey. *Addict Behav*. 2005;30(4):789-805.
6. McCabe SE, Knight JR, Teter CJ, Wechsler H. Non-medical use of prescription stimulants among US college students: Prevalence and correlates from a national survey. *Addiction*. 2005;99(1):96-106.
7. O'Grady KE, Arria AM, Fitzelle DB, Wish ED. Heavy drinking and polydrug use among college students. *J Drug Issues*. 2008;39(2):445-466.
8. Wolaver AM. Effects of heavy drinking in college on study effort, grade point average, and major choice. *Contemp Econ Policy*. 2002;20(4):415-428.
9. Arria AM, O'Grady KE, Caldeira KM, Vincent KB, Wish ED. Nonmedical use of prescription stimulants and analgesics: Associations with social and academic behaviors among college students. *J Drug Issues*. 2008;38(4):1045-1060.
10. Williams J, Powell LM, Wechsler H. Does alcohol consumption reduce human capital accumulation? Evidence from the College Alcohol Study. *Appl Econ*. 2003;35(10):1227-1239.
11. Arria AM, Wilcox HC, Caldeira KM, Vincent KB, Garnier-Dykstra LM, O'Grady KE. Dispelling the myth of "smart drugs": Cannabis and alcohol use problems predict nonmedical use of prescription stimulants for studying. *Addict Behav*. 2013;38(3):1643-1650.
12. Arria AM, Garnier-Dykstra LM, Caldeira KM, Vincent KB, Winick ER, O'Grady KE. Drug use patterns and continuous enrollment in college: Results from a longitudinal study. *J Stud Alcohol Drugs*. 2013;74(1):71-83.
13. Martinez JA, Sher KJ, Wood PK. Is heavy drinking really associated with attrition from college? The alcohol-attrition paradox. *Psychol Addict Behav*. 2008;22(3):450-456.
14. Weitzman ER. Poor mental health, depression, and associations with alcohol consumption, harm, and abuse in a national sample of young adults in college. *J Nerv Ment Dis*. 2004;192(4):269-277.
15. National Institute on Drug Abuse. *Drugs, brains, and behavior: The science of addiction*. (NIH Pub No. 10-5605). Bethesda, MD: National Institutes of Health; 2010.
16. DuPont RL, Caldeira KM, DuPont HS, Vincent KB, Shea CL, Arria AM. *America's dropout crisis: The unrecognized connection to adolescent substance use*. Rockville, MD: Institute for Behavior and Health; 2013.
17. Ipsos Public Affairs. *How America pays for college 2012*. Washington, DC: Sallie Mae; 2012.
18. Department of Education. *Fiscal year 2013 budget summary and background information*. Washington, DC: Department of Education; 2012.
19. Department of Veterans Affairs. *FY2013 Department of Veterans Affairs budget summary - Volume I*. Washington, DC: Department of Veterans Affairs; 2012.
20. Taylor P, Parker K, Fry R, Cohn DV, Wang W, Velasco G, Dockterman D. *Is college worth it?* Washington, DC: Pew Research Center; 2011.
21. National Center for Education Statistics. Integrated postsecondary education data system. 2012; <http://nces.ed.gov/ipeds/>. Accessed January 17, 2012.
22. National Center for Public Policy and Higher Education. *Measuring up 2008: The national report card on higher education*. San Jose, CA: National Center for Public Policy and Higher Education; 2008.
23. Caldeira KM, Arria AM, O'Grady KE, Vincent KB, Wish ED. The occurrence of cannabis use disorders and other cannabis-related problems among first-year college students. *Addict Behav*. 2008;33(3):397-411.

24. King KM, Meehan BT, Trim RS, Chassin L. Marker or mediator? The effects of adolescent substance use on young adult educational attainment. *Addiction*. 2006;101(12):1730-1740.
25. Arria AM, Kuhn V, Caldeira KM, O'Grady KE, Vincent KB, Wish ED. High school drinking mediates the relationship between parental monitoring and college drinking: A longitudinal analysis. *Subst Abuse Treat Prev Policy*. 2008;3(6):1-11.
26. Schulenberg J, O'Malley PM, Bachman JG, Wadsworth KN, Johnston LD. Getting drunk and growing up: Trajectories of frequent binge drinking during the transition to young adulthood. *J Stud Alcohol*. 1996;57(3):289-304.
27. Johnston LD, O'Malley PM, Bachman JG, Schulenberg JE. *Monitoring the Future: National survey results on drug use, 1975-2011: Volume I: Secondary school students*. Ann Arbor: Institute for Social Research, The University of Michigan; 2012.
28. Pinchevsky GM, Arria AM, Caldeira KM, Garnier-Dykstra LM, Vincent KB, O'Grady KE. Marijuana exposure opportunity and initiation during college: Parent and peer influences. *Prev Sci*. 2012;13(1):43-54.
29. Breslau J, Lane M, Sampson N, Kessler RC. Mental disorders and subsequent educational attainment in a US national sample. *J Psychiatr Res*. 2008;42(9):708-716.
30. Hunt J, Eisenberg D, Kilbourne AM. Consequences of receipt of a psychiatric diagnosis for completion of college. *Psychiatr Serv*. 2010;61(4):399-404.
31. Arria AM, Garnier-Dykstra LM, Cook ET, Caldeira KM, Vincent KB, Baron RA, O'Grady KE. Drug use patterns in young adulthood and post-college employment. *Drug Alcohol Depend*. 2013;127(1-3):23-30.
32. Arria AM, Caldeira KM, Vincent KB, Winick ER, Baron RA, O'Grady KE. Discontinuous college enrollment: Associations with substance use and mental health. *Psychiatr Serv*. 2013;64(2):165-172.
33. Pascarella ET, Tagliapietra-Nicoli G, Goodman KM, Park S, Seifert TA, Whitt EJ. College student binge drinking and academic achievement: A longitudinal replication and extension. *J Coll Stud Dev*. 2007;48(6):715-727.
34. Ganderton PT, Santos R. Hispanic college attendance and completion: Evidence from the high school and beyond surveys. *Econ Educ Rev*. 1995;14(1):35-46.
35. Jennison KM. The short-term effects and unintended long-term consequences of binge drinking in college: A 10-year follow-up study. *Am J Drug Alcohol Abuse*. 2004;30(3):659-684.
36. White AM, Swartzwelder HS. Age-related effects of alcohol on memory and memory-related brain function in adolescents and adults. In: Galanter M, ed. *Recent developments in alcoholism*. New York, NY: Kluwer Academic/Plenum Publishers; 2005:161-176.
37. Singleton RA, Wolfson AR. Alcohol consumption, sleep, and academic performance among college students. *J Stud Alcohol Drugs*. 2009;70(3):355-363.
38. Gliksman L, Newton-Taylor B, Adlaf E, Giesbrecht N. Alcohol and other drug use by Ontario university students: The roles of gender, age, year of study, academic grades, place of residence and programme of study. *Drugs (Abingdon Engl)*. 1997;4(2):117-129.
39. Thompson KM. Alcohol-related legal infractions and student retention. *J Stud Alcohol Drugs*. 2007;68(5):689-696.
40. Mezquita L, Stewart SH, Ruipérez Á. Big-five personality domains predict internal drinking motives in young adults. *Pers Individ Dif*. 2010;49(3):240-245.
41. Rosander P, Backstrom M, Stenberg G. Personality traits and general intelligence as predictors of academic performance: A structural equation modelling approach. *Learn Individ Differ*. 2011;21(5):590-596.
42. Ashton CH. Pharmacology and effects of cannabis: A brief review. *Br J Psychiatry*. 2001;178(2):101-106.
43. Schierenbeck T, Riemann D, Berger M, Hornyak M. Effect of illicit recreational drugs upon sleep: Cocaine, ecstasy and marijuana. *Sleep Med Rev*. 2008;12(5):381-389.
44. Tapert SF, Granholm E, Leedy NG, Brown SA. Substance use and withdrawal: Neuropsychological functioning over 8 years in youth. *J Int Neuropsychol Soc*. 2002;8(7):873-883.
45. Zeigler DW, Wang CC, Yoast RA, Dickinson BD, McCaffree MA, Robinowitz CB, Sterling ML. The neurocognitive effects of alcohol on adolescents and college students. *Prev Med*. 2005;40(1):23-32.
46. Brown SA, Tapert SF, Granholm E, Delis DC. Neurocognitive functioning of adolescents: Effects of protracted alcohol use. *Alcohol Clin Exp Res*. 2000;24(2):164-171.

47. Crean RD, Crane NA, Mason BJ. An evidence based review of acute and long-term effects of cannabis use on executive cognitive functions. *J Addict Med.* 2011;5(1):1-8.
48. Hall W. The adverse health effects of cannabis use: What are they, and what are their implications for policy? *Int J Drug Policy.* 2009;20(6):458-466.
49. Hall W, Degenhardt L. Adverse health effects of non-medical cannabis use. *Lancet.* 2009;374(9698):1383-1391.
50. Schweinsburg AD, Brown SA, Tapert SF. The influence of marijuana use on neurocognitive functioning in adolescents. *Curr Drug Abuse Rev.* 2008;1(1):99-111.
51. Fontes MA, Bolla KI, Cunha PJ, Almeida PP, Jungerman F, Laranjeira RR, Bressan RA, Lacerda ALT. Cannabis use before age 15 and subsequent executive functioning. *Br J Psychiatry.* 2011;198(6):442-447.
52. Ehrenreich H, Rinn T, Kunert HJ, Moeller MR, Poser W, Schilling L, Gigerenzer G, Hoehe MR. Specific attentional dysfunction in adults following early start of cannabis use. *Psychopharmacology.* 1999;142(3):295-301.
53. Pope HG, Jr., Gruber AJ, Hudson JI, Cohane G, Huestis MA, Yurgelun-Todd D. Early-onset cannabis use and cognitive deficits: What is the nature of the association? *Drug Alcohol Depend.* 2003;69(3):303-310.
54. Bolla KI, Brown K, Eldreth D, Tate K, Cadet JL. Dose-related neurocognitive effects of marijuana use. *Neurology.* 2002;59(9):1337-1343.
55. Solowij N, Stephens RS, Roffman RA, Babor T, Kadden R, Miller M, Christiansen K, McRee B, Vendetti J. Cognitive functioning of long-term heavy cannabis users seeking treatment. *JAMA.* 2002;287(9):1123-1131.
56. Hanson KL, Cummins K, Tapert SF, Brown SA. Changes in neuropsychological functioning over 10 years following adolescent substance abuse treatment. *Psychol Addict Behav.* 2011;25(1):127-142.
57. Schwartz RH, Gruenewald PJ, Klitzner M, Fedio P. Short-term memory impairment in cannabis-dependent adolescents. *Am J Dis Child.* 1989;143(10):1214-1219.
58. Solowij N, Jones K, Rozman M, Davis S, Ciarrochi J, Heaven PL, Lubman D, Yücel M. Verbal learning and memory in adolescent cannabis users, alcohol users and non-users. *Psychopharmacology.* 2011;216(1):131-144.
59. Takagi M, Yucel M, Cotton SM, Baliz Y, Tucker A, Elkins K, Lubman DI. Verbal memory, learning, and executive functioning among adolescent inhalant and cannabis users. *J Stud Alcohol Drugs.* 2011;72(1):96-105.
60. Meier MH, Caspi A, Ambler A, Harrington H, Houts R, Keefe RSE, McDonald K, Ward A, Poulton R, Moffitt TE. Persistent cannabis users show neuropsychological decline from childhood to midlife. *Proc Natl Acad Sci USA.* 2012;109(40):E2657-2664.
61. de la Jara R. IQ percentile and rarity chart. 2006; <http://www.iqcomparisonsite.com/iqtable.aspx>. Accessed May 1, 2013.
62. Regier DA, Farmer ME, Rae DS, Locke BZ, Keith SJ, Judd LL, Goodwin FK. Comorbidity of mental disorders with alcohol and other drug abuse. *JAMA.* 1990;264(19):2511-2519.
63. Compton WM, Thomas YF, Stinson FS, Grant BF. Prevalence, correlates, disability, and comorbidity of DSM-IV drug abuse and dependence in the United States: Results from the National Epidemiologic Survey on Alcohol and Related Conditions. *Arch Gen Psychiatry.* 2007;64(5):566-576.
64. Griffith-Lendering MF, Wigman JT, Prince van Leeuwen A, Huijbregts SC, Huizink AC, Ormel J, Verhulst FC, van Os J, Swaab H, Vollebergh WA. Cannabis use and vulnerability for psychosis in early adolescence-a TRAILS study. *Addiction.* 2013;108(4):733-740.
65. Bhattacharyya S, Crippa JA, Allen P, Martin-Santos R, Borgwardt S, Fusar-Poli P, Rubia K, Kambeitz J, O'Carroll C, Seal ML, Giampietro V, Brammer M, Zuardi AW, Atakan Z, McGuire PK. Induction of psychosis by Delta 9-tetrahydrocannabinol reflects modulation of prefrontal and striatal function during attentional salience processing. *Arch Gen Psychiatry.* 2012;69(1):27-36.
66. Foti DJ, Kotov R, Guey LT, Bromet EJ. Cannabis use and the course of schizophrenia: 10-year follow-up after first hospitalization. *Am J Psychiatry.* 2010;167(8):987-993.
67. Fergusson DM, Horwood LJ, Ridder EM. Tests of causal linkages between cannabis use and psychotic symptoms. *Addiction.* 2005;100(3):354-366.
68. Patton GC, Coffey C, Carlin JB, Degenhardt L, Lynskey M, Hall W. Cannabis use and mental health in young people: Cohort study. *BMJ.* 2002;325(7374):1195-1198.

69. Zammit S, Allebeck P, Andreasson S, Lundberg I, Lewis G. Self reported cannabis use as a risk factor for schizophrenia in Swedish conscripts of 1969: Historical cohort study. *BMJ*. 2002;325(7374):1199-1203S.
70. Blanco C, Okuda M, Wright C, Hasin DS, Grant BF, Liu S-M, Olfson M. Mental health of college students and their non-college-attending peers. *Arch Gen Psychiatry*. 2008;65(12):1429-1437.
71. Eisenberg D, Gollust SE, Golberstein E, Hefner JL. Prevalence and correlates of depression, anxiety, and suicidality among university students. *Am J Orthopsychiatry*. 2007;77(4):534-542.
72. Kessler RC, Foster CL. Social consequences of psychiatric disorders, I: Educational attainment. *Am J Psychiatry*. 1995;152(7):1026-1032.
73. Andersson C, Johnsson KO, Berglund M, Öjehagen A. Stress and hazardous alcohol use: Associations with early dropout from university. *Scand J Public Health*. 2009;37(7):713-719.
74. Eisenberg D, Golberstein E, Hunt JB. Mental health and academic success in college. *BE J Econ Anal Policy*. 2009;9(1):1-35.
75. Miller P, ed. *Interventions for addiction: Comprehensive addictive behaviors and disorders, volume 3*. 1st ed. Waltham, MA: Academic Press; 2013.
76. Winters KC, Nelson TF. *Preventing binge drinking on college campuses*. Center City, MN: Hazelden Press; 2012.
77. Jed Foundation and Education Development Center Inc. *A guide to campus mental health action planning*. New York, NY: The Jed Foundation CampusMHAP and EDC, Inc.; 2011.
78. Hunt J, Eisenberg D. Mental health problems and help-seeking behavior among college students. *J Adolesc Health*. 2010;46(1):3-10.
79. Engberg J, Morral AR. Reducing substance use improves adolescents' school attendance. *Addiction*. 2006;101(12):1741-1751.
80. Borsari B, Carey KB. Effects of a brief motivational intervention with college student drinkers. *J Consult Clin Psychol*. 2000;68(4):728-733.
81. Carey KB, Carey MP, Maisto SA, Henson JM. Brief motivational interventions for heavy college drinkers: A randomized controlled trial. *J Consult Clin Psychol*. 2006;74(5):943-954.
82. Kulesza M, McVay MA, Larimer ME, Copeland AL. A randomized clinical trial comparing the efficacy of two active conditions of a brief intervention for heavy college drinkers. *Addict Behav*. 2013;38(4):2094-2101.
83. Helmkamp JC, Hungerford DW, Williams JM, Manley WG, Furbee PM, Horn KA, Pollock DA. Screening and brief intervention for alcohol problems among college students treated in a university hospital emergency department. *J Am Coll Health*. 2003;52(1):7-16.
84. Hustad JTP, Barnett NP, Borsari B, Jackson KM. Web-based alcohol prevention for incoming college students: A randomized controlled trial. *Addict Behav*. 2010;35(3):183-189.
85. Dill AL, Gilbert JA, Hill JP, Minchew SS, Sempier TA. A successful retention program for suspended students. *J Coll Stud Ret*. 2010;12(3):277-291.
86. Scribner RA, Theall KP, Mason K, Simonsen N, Schneider SK, Towvim LG, Dejong W. Alcohol prevention on college campuses: The moderating effect of the alcohol environment on the effectiveness of social norms marketing campaigns. *J Stud Alcohol Drugs*. 2011;72(2):232-239.
87. National Institute on Alcohol Abuse and Alcoholism. *Fact sheet: College drinking*. Bethesda, MD: National Institute on Alcohol Abuse and Alcoholism; 2012.
88. Scribner R, Mason K, Theall K, Simonsen N, Schneider SK, Towvim LG, deJong W. The contextual role of alcohol outlet density in college drinking. *J Stud Alcohol Drugs*. 2008;69(1):112-120.
89. The Task Force on Community Preventative Services. Recommendations for reducing excessive alcohol consumption and alcohol-related harms by limiting alcohol outlet density. *Am J Prev Med*. 2009;37(6):570-571.
90. Guide to Community Preventative Services. Preventing excessive alcohol consumption: Enforcement of laws prohibiting sales to minors. 2006; <http://www.thecommunityguide.org/alcohol/lawsprohibitingsales.html>. Accessed April 3, 2013.