DukeHealth

Duke | SOCIAL SCIENCE RESEARCH INSTITUTE

UNC SCHOOL OF MEDICINE
BOWLES CENTER FOR ALCOHOL STUDIES

THE UNIVERSITY of NORTH CAROLINA at CHAPEL HILL

UNC CHARLOTTE

Wake Forest® School of Medicine

Alcohol & The Adolescent Brain: Immediate Impairment, Long-Term Consequences

Presented to the Office of Governor Pat McCrory — January 2016

The future of North Carolina depends on its young people. We want to protect and nurture them as they grow and develop. As parents and responsible adults, we stay alert and vigilant to keep children out of harm's way. All too often, however, we don't even consider potential dangers to their most important organ: the brain.

We rarely stop to ask the critical questions: How does the brain develop? What can interfere with that process? And what do kids' developing brains need to make the most of their education and become productive adults?

Adolescent Brains Aren't Broken. They're A Work In Progress.

The human brain continues to mature from birth into the mid-20s. The back parts (pons and medulla) — which regulate essential processes such as breathing and heart rate — function properly at birth. The front parts (frontal cortex) — responsible for sophisticated thinking like prioritizing, planning and self-reflection — are the last to mature. By the time a child is about 10, he or she has most of his or her neurons, which have been actively making connections with each other since before birth.

The last phase of brain development, however, occurs during adolescence, when bodies and brains change in remarkable ways. This phase is critical for adolescents' future success in just about all facets of life.

Adolescent Brains Are Not The Same As Adult Brains.

As the body matures, the hormonal changes of puberty affect mood, social interests and interaction with peers. At the same time, children's brains are changing in important ways.

Two national programs studying exactly how alcohol changes the adolescent brain include groups from North Carolina.

- The NCANDA (National Consortium on Alcohol and Neurodevelopment in Adolescence) includes scientists at Duke and UNC.
- The NADIA (Neurobiology of Adolescent Drinking in Adulthood) Consortium includes scientists at the Bowles Center for Alcohol Studies at UNC and at Duke.

Additional studies on alcohol and the developing brain are conducted in individual laboratories at Duke, UNC-Chapel Hill, UNC-Charlotte and Wake Forest University.

The emotional areas of the brain mature before the frontal cortex — evident in the thrill-seeking, risky decision-making, and impulsiveness that define adolescence. The process of maturation that allows the "executive area" in the frontal cortex to take control over the rest of the brain isn't complete until age 22-25.

Until this happens, adolescent brains respond more to both the promise of rewards and to threats (especially social threats) than adult brains, and they weigh immediate rewards as more valuable than future rewards. This different "brain balance" is why adolescents pay lots of attention to their peers, and why they are more likely to do something without considering the consequences.

It becomes the job of responsible adults in kids' lives to help provide the restraint that their own brains often can't.

Four Factors Can Impact Brain Development And Learning.

Young brains need the right conditions to learn and develop optimally — conditions that are directly affected by four critical elements. The first three:

- **SLEEP:** The average adolescent needs more than an adult (8–9 hours/night). Sleep helps the brain recover from the day and consolidate what was learned, and it is critical for maturation of body and brain.

- **EXERCISE:** Exercise helps attention, memory and other cognitive functions. It can actually promote the formation of new neurons in the part of the brain associated with some forms of memory (hippocampus) and improve the memories laid down in this area.

- **STRESS:** Excessive stress changes brain structure and function as much as exercise — in the wrong direction. Chronic stress makes the amygdala (the area that signals "threat") more sensitive to threat because of changes in the neurons there.

Alcohol: The Fourth Factor — And Often Enemy #1.

Just as many parents aren't aware of the dramatic changes occurring in the brains of their growing children, most don't realize how significantly alcohol can interfere with normal development.

This is not just an academic concern: At least one fifth of North Carolina students start drinking alcohol by age 14. Various surveys of alcohol use in adolescents ask questions a little differently, but most national surveys report that the average age that kids begin drinking alcohol is 15–16. By the end of high school, 72 percent of high school students have consumed alcohol at least once, and about 40 percent of kids have used alcohol in the last 30 days.

So let's take a careful look at what can actually happen to the brain when a child drinks — both the effects that are felt right away, and changes that can last a lifetime.

Short-Term Impairment.

Intoxicated brains do not function well, even for some time after the buzz is gone. It's also important to keep in mind that adolescents are not just "young adults" when it comes to alcohol — kids process alcohol differently and experience different consequences.

- *Adolescents are less sedated by alcohol than adults.* This allows them to keep drinking past the point at which older people would have stopped.

- *Alcohol reduces "social anxiety" even better in adolescents than adults.* Kids are more likely to drink alcohol to "fit in" and feel comfortable in social situations. Peer approval is incredibly important at a young age; kids who hang out with others who are drinking experience a great deal of social pressure to participate.

- *Together, these factors make adolescents more likely to binge drink (four to five or more drinks at a time) than adults.*

- *Binge drinking in adolescents leads to more negative consequences than in adults,* such as blackouts (loss of memory from the event), unplanned and unwanted sexual activity, fights, accidents and driving while intoxicated.

- *Alcohol affects learning more in adolescents,* and also interferes with other "brain health" behaviors, undoing the benefits of good health habits. It interferes with sleep, and slows recovery from intense exercise in athletes. There is a particularly toxic interaction of stress and alcohol use: Adolescents with a history of remote or recent stress are likely to drink more alcohol, and heavy alcohol use increases their reactions to stress.

Long-Term Consequences.

Drinking during adolescence doesn't just affect a child while he or she is drinking — it has outcomes that may be lifelong.

- *The brains of adolescent alcohol drinkers differ from those of nondrinkers.* Certain parts of the brain are actually smaller in the brains of people who started heavy alcohol drinking as children or adolescents.

- *The hippocampus is particularly vulnerable.* Although most areas of the brain reach their peak size and number of cells during early adolescence, the hippocampus — a part of the brain critical for learning and memory — continues to form new cells throughout life. These new cells are crucial for the memory tasks supported by the hippocampus. Adolescent alcohol exposure causes a dramatic shutdown of this process, one that can continue into adult life. This may be one reason that aspects of learning that require the hippocampus are impaired into adulthood. In addition, adolescent alcohol exposure reduces the number of neurons in the brain that make the neurotransmitter acetylcholine. While the behavioral effects of this loss are not yet known for sure, some of these neurons are also thought to be critical for learning.

- *Adolescent alcohol use sets up a persistent increase in activation of brain signals that contribute to inflammation.* The consequences of this are unclear, but similar changes have been associated with depression in adults, and suggest that early alcohol use may set kids up for mood problems in adulthood.

- *Binge levels of alcohol in adolescence can cause changes in brain development and brain function.* In laboratory studies, rodents exposed to "binge" levels of alcohol during adolescence can be more uninhibited and impulsive as adults than unexposed animals, and make riskier decisions. While they can learn to perform a specific action to earn a reward, or learn to navigate a maze, they do worse than unexposed rats when the rules change. These differences point to a reduction in "behavioral flexibility," the ability to change behavior when the occasion calls for it — a critical component of decision making required for life in the adult world.

- *The younger someone starts, the greater the chances he or she will have alcohol use problems in their lifetime.* It is hard to know whether this is due to the alcohol exposure and/or to genetics, family environment, or a predisposing personality. We do know that about 50 percent of the risk for alcoholism is inherited, but many factors may contribute to this genetic vulnerability in adolescents, including availability of drugs, peer groups and whether a parent is using drugs.

- *Alcohol can cause specific changes in the brain that could increase risk for alcohol-use problems.* The biggest concern is that the way adolescents often drink (binging with many drinks at a time) likely causes the most long-term damage to the brain. Research in laboratory rats and mice has shown that adolescents who binge a lot can eventually develop withdrawal symptoms, including increased anxiety and (in extreme cases) seizures more severe than typically occur in adults with a similar binging history. Postmortem studies show that the brains of alcoholics who began drinking in adolescence show changes similar to adolescent binge drinkers.

Ongoing Research. Mounting Costs.

A key question facing researchers is whether alcohol itself is causing these brain and behavior changes in humans, or whether other factors like environment, parental behavior and genetics create an adolescent brain that is "primed" for alcohol. Unraveling this "chicken-or-egg" question is crucial to providing effective treatments for youth affected by drinking.

As this work continues in earnest, we all must grapple with a sobering reality: In addition to the violence, accidents, unplanned pregnancies and injuries that can occur with underage drinking, the research suggests that there will be long-term impacts on public health.

The Power Of Parents.

All of this information is a lot to absorb. The most important takeaway is that parents and responsible adults have a responsibility to act.

The facts laid out here should empower parents to express opinions about alcohol use and to provide limits on their children's access to alcohol. Studies show over and over that parental behavior and communication can delay the initiation of alcohol consumption. Both words and deeds matter.

Starting The Conversation.

- Parents need to tell their kids what their family values are about drinking.

- They need to "walk the walk" as well as "talk the talk" — which means being mindful of their own behavior in front of their kids.

- They need to remember a few critical facts, such as:
    - *Because of their unique response to alcohol, particularly a much less pronounced "sedative" response than in adults, adolescents are prone to drinking in "binges."*
    - *Excessive drinking has short-term consequences such as risky behavior, blackouts and accidents, and problems with memory and learning.*
    - *Binge drinking has long-term consequences that can persist into adulthood, even if drinking stops. These include changes in key brain systems and behaviors that affect health.*
    - *Preventing underage drinking in the first place is the only way to make sure your brain is protected.*
    - ***Binge drinking during adolescence can permanently change your life trajectory.***

Stopping Underage Drinking.

The adolescent brain is still developing and is uniquely sensitive to alcohol. When a child drinks, judgment, memory, learning and recovery can all be compromised. While multiple factors impact brain development, current science suggests lifelong changes in the brain are induced by binge drinking in adolescence. Parental efforts to prevent access to alcohol will increase the chances of North Carolina's children optimizing their abilities and talents.

The Authors

Dr. Cynthia Kuhn
Professor of Pharmacology and Cancer Biology, Psychology and Psychiatry
Duke University Medical Center

Dr. Kuhn studies the effects of drugs including alcohol on developing adolescents in animal models, with a focus on how males and females may respond differently. She has shown that sex differences in dopamine function emerge during puberty, and contribute to the emergence of sex-specific responses to addictive drugs. She has collaborated with Drs. Wilson and Swartzwelder in studying the effects of ethanol on the developing brain for many years.

Dr. Wilkie Wilson
Professor of Prevention Science
Duke University Social Sciences Research Institute

Dr. Wilson is a neuroscientist who has made seminal findings about how the hippocampus functions in its normal state, during epilepsy and after exposure to alcohol during adolescence. He and Dr. Kuhn have worked with North Carolina educators to develop and pilot a healthful living curriculum that emphasizes brain health for high school students.

Drs. Kuhn and Wilson, along with Dr. Scott Swartzwelder, wrote "Buzzed, The Straight Facts about the Effects of Drugs from Alcohol to Ecstasy," which is now in its 4th edition. They lecture widely to professional and lay audiences about adolescence and the effects of recreational drugs on the adolescent brain.

Dr. Fulton Crews
John Andrews Distinguished Professor of Pharmacology and Psychiatry
Director of the Bowles Center for Alcohol Studies
University of North Carolina at Chapel Hill

Dr. Crews has discovered mechanisms of alcohol-induced brain damage using rodents and postmortem human alcoholic brains. These led to a focus on adolescent brain development, which he discovered is uniquely sensitive to alcohol-induced damage. His lab found that adolescent alcohol use changes aspects of brain health and signaling, such as the loss of formation of new neurons and increases in neuroimmune signals, changes that can persist for life. He leads the national NADIA Consortium of scientists studying the consequences of underage alcohol on the adolescent brain, funded by the National Institute of Health.

Dr. Donita L. Robinson
Associate Professor of Psychiatry
Bowles Center for Alcohol Studies
University of North Carolina at Chapel Hill

Dr. Robinson studies behavioral and motivational brain circuits and how they are altered by drugs such as alcohol and nicotine. The Robinson lab found that binge levels of alcohol during adolescence can disrupt the effects of alcohol on dopamine later in adulthood in ways that may make alcohol more rewarding. In collaboration with others, her lab also found that binge levels of alcohol during adolescence can dampen connections between the prefrontal cortex — the decision-making area of the brain that is still developing during adolescence — and parts of the brain that control motivation and reward-learning. Dr. Robinson is also head of the Education Core of the UNC limb of the NADIA, and organizes public outreach activities of the NADIA in North Carolina.

Bibliography

(*Studies authored by **North Carolina scientists** are depicted in bold*)

ADOLESCENT BRAIN

Casey, B.J., Jones, R.M., Levita, L., Libby, V., Pattwell, S.S., Ruberry, E.J., & Somerville, L.H. (2010). The storm and stress of adolescence: insights from human imaging and mouse genetics. *Dev Psychobiol, 52*(3), 225-235.

Chambers, R.A., Taylor, J.R., & Potenza, M.N. (2003). Developmental neurocircuitry of motivation in adolescence: a critical period of addiction vulnerability. *Am J Psychiatry, 160*(6), 1041-1052.

Dosenbach, N.U., Nardos, B., Cohen, A.L., Fair, D.A., Power, J.D., Church, J.A., & Schlaggar, B.L. (2010). Prediction of individual brain maturity using fMRI. *Science, 329*(5997), 1358-1361.

Ernst, M. & Fudge, J.L. (2009). A developmental neurobiological model of motivated behavior: anatomy, connectivity and ontogeny of the triadic nodes. *Neurosci Biobehav Rev, 33*(3), 367-382.

Ernst, M., Pine, D.S., & Hardin, M. (2006). Triadic model of the neurobiology of motivated behavior in adolescence. *Psychol Med, 36*(3), 299-312.

Ernst, M., Romeo, R.D., & Andersen, S.L. (2009). Neurobiology of the development of motivated behaviors in adolescence: a window into a neural systems model. *Pharmacol Biochem Behav, 93*(3), 199-211.

Gogtay, N., Giedd, J.N., Lusk, L., Hayashi, K.M., Greenstein, D., Vaituzis, A.C., & Thompson, P.M. (2004). Dynamic mapping of human cortical development during childhood through early adulthood. *Proc Natl Acad Sci USA, 101*(21), 8174-8179.

Gogtay, N., Nugent, T.F., III, Herman, D.H., Ordonez, A., Greenstein, D., Hayashi, K.M., Thompson, P.M. (2006). Dynamic mapping of normal human hippocampal development. *Hippocampus, 16*(8), 664-672.

Richards, J.M., Plate, R.C., & Ernst, M. (2012). Neural systems underlying motivated behavior in adolescence: implications for preventive medicine. *Prev Med, 55 Suppl,* S7-S16.

Spear, L.P. (2011). Rewards, aversions and affect in adolescence: emerging convergences across laboratory animal and human data. *Dev Cogn Neurosci, 1*(4), 392-400.

Shaw, P., Kabani, N.J., Lerch, J.P., Eckstrand, K., Lenroot, R., Gogtay, N., & Wise, S.P. (2008). Neurodevelopmental trajectories of the human cerebral cortex. *J Neurosci, 28*(14), 3586-3594.

SLEEP, EXERCISE, STRESS

Andrade, M.M., Benedito-Silva, A.A., Domenice, S., Arnhold, I.J., & Menna-Barreto, L. (1993). Sleep characteristics of adolescents: a longitudinal study. *J Adolesc Health, 14*(5), 401-406.

Bale, T.L. (2006). Stress sensitivity and the development of affective disorders. *Horm Behav, 50*(4), 529-533.

Carskadon, M.A. (2011). Sleep's effects on cognition and learning in adolescence. *Prog Brain Res, 190*, 137-143.

Cotman, C.W., Berchtold, N.C., & Christie, L.A. (2007). Exercise builds brain health: key roles of growth factor cascades and inflammation. *Trends Neurosci, 30*(9), 464-472.

Dewald, J.F., Meijer, A.M., Oort, F.J., Kerkhof, G.A., & Bogels, S.M. (2010). The influence of sleep quality, sleep duration and sleepiness on school performance in children and adolescents: a meta-analytic review. *Sleep Med Rev, 14*(3), 179-189.

Gomes da Silva, S. & Arida, R.M. (2015). Physical activity and brain development. *Expert Rev Neurother, 15*(9), 1041-1051.

Herting, M.M. & Nagel, B.J. (2013). Differences in brain activity during a verbal associative memory encoding task in high- and low-fit adolescents. *J Cogn Neurosci, 25*(4), 595-612.

Hotting, K. & Roder, B. (2013). Beneficial effects of physical exercise on neuroplasticity and cognition. *Neurosci Biobehav Rev, 37*(9 Pt B), 2243-2257.

Den, M.L. & Richardson, R. (2013). Enhanced sensitivity to learning fearful associations during adolescence. *Neurobiol Learn Mem, 104C*, 92-102.

Jiang, F., VanDyke, R.D., Zhang, J., Li, F., Gozal, D., & Shen, X. (2011). Effect of chronic sleep restriction on sleepiness and working memory in adolescents and young adults. *J Clin Exp Neuropsychol, 33*(8), 892-900.

Laberge, L., Petit, D., Simard, C., Vitaro, F., Tremblay, R.E., & Montplaisir, J. (2001). Development of sleep patterns in early adolescence. *J Sleep Res, 10*(1), 59-67.

Malter Cohen, M., Tottenham, N., & Casey, B.J. (2013). Translational developmental studies of stress on brain and behavior: implications for adolescent mental health and illness? *Neuroscience, 249*, 53-62.

Patrick, M.E. & Schulenberg, J.E. (2013). Prevalence and predictors of adolescent alcohol use and binge drinking in the United States. *Alcohol Res, 35*:193-200.

Pattwell, S.S., Duhoux, S., Hartley, C.A., Johnson, D.C., Jing, D., Elliott, M.D., & Lee, F.S. (2012). Altered fear learning across development in both mouse and human. *Proc Natl Acad Sci USA, 109*(40), 16318-16323.

Thorpy, M.J., Korman, E., Spielman, A.J., & Glovinsky, P.B. (1988). Delayed sleep phase syndrome in adolescents. *J Adolesc Health Care, 9*(1), 22-27.

Toledo-Rodriguez, M. & Sandi, C. (2011). Stress during adolescence increases novelty seeking and risk-taking behavior in male and female rats. *Front Behav Neurosci, 5*, 17.

Wolfson, A.R. & Carskadon, M.A. (1998). Sleep schedules and daytime functioning in adolescents. *Child Dev, 69*(4), 875-887.

ALCOHOL USE STATISTICS

2011. Vital signs: binge drinking among high school students and adults — United States, 2009. *MMWR Morb Mortal Wkly Rep*, *59*, 1274-9.

Clark, T.T., Doyle, O., & Clincy, A. (2013). Age of first cigarette, alcohol, and marijuana use among U.S. biracial/ethnic youth: a population-based study. *Addict Behav, 38*:2450-2454.

Cook, P.J. & Moore, M.J. (2002). The economics of alcohol abuse and alcohol-control policies. *Health Aff (Millwood), 21*:120-133.

Jackson, K.M., Sher, K.J., Cooper, M.L., & Wood, P.K. (2002). Adolescent alcohol and tobacco use: onset, persistence and trajectories of use across two samples. *Addiction, 97*:517-531.

Monitoring the Future Study, 2015

National Household Survey on Drug Use and Health, 2014

Pitkanen, T., Lyyra, A.L., & Pulkkinen, L. (2005). Age of onset of drinking and the use of alcohol in adulthood: a follow-up study from age 8-42 for females and males. *Addiction, 100*:652-661.

Patrick, M.E., Schulenberg, J.E., Martz, M.E., Maggs, J.L., O'Malley, P.M., & Johnston, L.D. (2013). Extreme binge drinking among 12th-grade students in the United States: prevalence and predictors. *JAMA Pediatr, 167*:1019-1025.

White, A.M., Kraus C.L., & Swartzwelder, H. (2006). Many college freshmen drink at levels far beyond the binge threshold. *Alcohol Clin Exp Res, 30*:1006-1010.

ENVIRONMENTAL, BEHAVIORAL AND GENETIC RISK FOR ADOLESCENT ALCOHOL DRINKING

Adkins, D.E., Clark, S.L., Copeland, W.E., Kennedy, M., Conway, K., Angold, A., Maes, H., Liu, Y., Kumar, G., Erkanli, A., Patkar, A.A., Silberg, J., Brown, T.H., Fergusson, D.M., Horwood, L.J., Eaves, L., van den Oord, E.J., Sullivan, P.F., & Costello, E.J. (2015). Genome-wide meta-analysis of longitudinal alcohol consumption across youth and early adulthood. *Twin Res Hum Genet, 18*:335-347.

Butler, T.R., Ariwodola, O.J., & Weiner, J.L. (2014). The impact of social isolation on HPA axis function, anxiety-like behaviors, and ethanol drinking. *Front Integr Neurosci, 7*:102.

Chappell A.M., Carter E., McCool B.A., & Weiner J.L. (2013). Adolescent rearing conditions influence the relationship between initial anxiety-like behavior and ethanol drinking in male Long Evans rats. *Alcohol Clin Exp Res, 37* Suppl 1:E394-403.

Champion, H.L., Foley, K.L., DuRant, R.H., Hensberry, R., Altman, D., & Wolfson, M. (2004). Adolescent sexual victimization, use of alcohol and other substances, and other health risk behaviors. *J Adolesc Health, 35*:321-328.

Chassin, L., Sher, K.J., Hussong, A., & Curran, P. (2013). The developmental psychopathology of alcohol use and alcohol disorders: research achievements and future directions. *Dev Psychopathol, 25*:1567-1584.

Choukas-Bradley, S., Giletta, M., Neblett, E.W., & Prinstein, M.J. (2015). Ethnic differences in associations among popularity, likability, and trajectories of adolescents' alcohol use and frequency. *Child Dev, 86*:519-535.

Clark, T.T., Corneille, M., & Coman, E. (2013). Developmental trajectories of alcohol use among monoracial and biracial black adolescents and adults. *J Psychoactive Drugs, 45*:249-257.

Ennett, S.T., Foshee, V.A., Bauman, K.E., Hussong, A., Cai, L., Reyes, H.L., Faris, R., Hipp, J., & Durant, R. (2008). The social ecology of adolescent alcohol misuse. *Child Dev, 79*:1777-1791.

Foshee, V.A., Benefield, T.S., Puvanesarajah, S., Reyes, H.L., Haberstick, B.C., Smolen, A., Ennett, S.T., & Suchindran, C. (2014). Self-regulatory failure and the perpetration of adolescent dating violence: examining an alcohol use by gene explanation. *Aggress Behav.*

Gorka, S.M., Liu, H., Klein, D., Daughters, S.B., & Shankman, S.A. (2015). Is risk-taking propensity a familial vulnerability factor for alcohol use? An examination in two independent samples. *J Psychiatr Res, 68*:54-60.

Green, K.M., Musci, R.J., Johnson, R.M., Matson, P.A., Reboussin B.A., & Lalongo N.S. (2016). Outcomes associated with adolescent marijuana and alcohol use among urban young adults: a prospective study. *Addict Behav, 53*:155-160.

Guo, G., Wilhelmsen, K., & Hamilton, N. (2007). Gene-lifecourse interaction for alcohol consumption in adolescence and young adulthood: five monoamine genes. *Am J Med Genet B Neuropsychiatr Genet, 144B*:417-423.

Hussong, A., Bauer, D., & Chassin, L. (2008). Telescoped trajectories from alcohol initiation to disorder in children of alcoholic parents. *J Abnorm Psychol, 117*:63-78.

Jones, A.S. (2007). Maternal alcohol abuse/dependence, children's behavior problems, and home environment: estimates from the *National Longitudinal Survey of Youth* using propensity score matching. *J Stud Alcohol Drugs, 68*:266-275.

Kampov-Polevoy, A., Lange, L., Bobashev, G., Eggleston, B., Root, T., & Garbutt, J.C. (2014). Sweet-liking is associated with transformation of heavy drinking into alcohol-related problems in young adults with high novelty seeking. *Alcohol Clin Exp Res, 38*:2119-2126.

Karkhanis, A.N., Alexander, N.J., McCool, B.A., Weiner, J.L., & Jones, S.R. (2015). Chronic social isolation during adolescence augments catecholamine response to acute ethanol in the basolateral amygdala. *Synapse, 69*:385-395.

Karkhanis, A.N., Locke, J.L., McCool, B.A., Weiner, J.L., & Jones, S.R. (2014). Social isolation rearing increases nucleus accumbens dopamine and norepinephrine responses to acute ethanol in adulthood. *Alcohol Clin Exp Res, 38*:2770-2779.

McNaughton Reyes, H.L., Foshee, V.A., Bauer, D.J., & Ennett, S.T. (2012). Heavy alcohol use and dating violence perpetration during adolescence: family, peer and neighborhood violence as moderators. *Prev Sci, 13*:340-349.

Paschall, M.J., Ringwalt, C.L., & Flewelling, R.L. (2002). Explaining higher levels of alcohol use among working adolescents: an analysis of potential explanatory variables. *J Stud Alcohol, 63*:169-178.

Peairs, K.F., Eichen, D., Putallaz, M., Costanzo, P.R., & Grimes C.L. (2011). Academic giftedness and alcohol use in early adolescence. *Gift Child Q, 55*:95-110.

Reboussin, B.A., Song, E.Y., & Wolfson, M. (2011). The impact of alcohol outlet density on the geographic clustering of underage drinking behaviors within census tracts. *Alcohol Clin Exp Res, 35*:1541-1549.

Reyes, H.L., Foshee, V.A., Bauer, D.J., & Ennett, S.T. (2012). Developmental associations between adolescent alcohol use and dating aggression. *J Res Adolesc, 22*:526-541.

Skelly, M.J., Chappell, A.E., Carter, E., & Weiner, J.L. (2015). Adolescent social isolation increases anxiety-like behavior and ethanol intake and impairs fear extinction in adulthood: possible role of disrupted noradrenergic signaling. *Neuropharmacology, 97*:149-159.

Wormington, S.V., Anderson, K.G., Tomlinson, K.L., & Brown, S.A. (2013). Alcohol and other drug use in middle school: the interplay of gender, peer victimization, and supportive social relationships. *J Early Adolesc, 33*:610-634.

ACUTE EFFECTS OF ALCOHOL IN ADOLESCENCE

Agoglia, A.E., Holstein, S.E., Eastman, V.R., & Hodge, C.W. (2016). Cannabinoid CB1 receptor inhibition blunts adolescent-typical increased binge alcohol and sucrose consumption in male C57BL/6J mice. *Pharmacol Biochem Behav, pii: S0091-3057*(16)30008-9.

Agoglia, A.E., Holstein, S.E., Reid, G., & Hodge, C.W. (2015). CaMKIIα-GluA1 activity underlies vulnerability to adolescent binge alcohol drinking. *Alcohol Clin Exp Res, 39*(9):1680-90.

Behrendt, S., Wittchen, H.U., Hofler, M., Lieb, R., Low, N.C., Rehm, J., & Beesdo, K. (2008). Risk and speed of transitions to first alcohol dependence symptoms in adolescents: a 10-year longitudinal community study in Germany. *Addiction, 103*:1638-1647.

Bingham, C.R., Shope, J.T., & Tang, X. (2005). Drinking behavior from high school to young adulthood: differences by college education. *Alcohol Clin Exp Res, 29*:2170-2180.

Brown, S.A., Brumback, T., Tomlinson, K., Cummins, K., Thompson, W.K., Nagel, B.J., De Bellis, M.D., Hooper, S.R., Clark, D.B., Chung, T., Hasler, B.P., Colrain, I.M., Baker, F.C., Prouty, D., Pfefferbaum, A, Sullivan, E.V., Pohl, K.M., Rohlfing, T., Nichols, B.N., Chu, W., & Tapert, S.F. (2015). The National Consortium on Alcohol and NeuroDevelopment in Adolescence (NCANDA): A multisite study of adolescent development and substance use. *J Stud Alcohol Drugs, 76*(6):895-908.

Chappell, A.M., Carter, E., McCool, B.A., & Weiner, J.L. (2013). Adolescent rearing conditions influence the relationship between initial anxiety-like behavior and ethanol drinking in male Long Evans rats. *Alcohol Clin Exp Res, 37* Suppl 1:E394-403.

Crews, F.T., Braun, C.J., Hoplight, B., Switzer, R.C., III, & Knapp, D.J. (2000). Binge ethanol consumption causes differential brain damage in young adolescent rats compared with adult rats. *Alcohol Clin Exp Res, 24*(11), 1712-1723.

Crews, F.T., Mdzinarishvili, A., Kim, D., He, J., & Nixon, K. (2006). Neurogenesis in adolescent brain is potently inhibited by ethanol. *Neuroscience, 137*(2), 437-445.

De Bellis, M.D., Narasimhan, A., Thatcher, D.L., Keshavan, M.S., Soloff, P, & Clark, D B (2005). Prefrontal cortex, thalamus, and cerebellar volumes in adolescents and young adults with adolescent-onset alcohol use disorders and comorbid mental disorders. *Alcohol Clin Exp Res, 29*:1590-1600.

Dick, D.M., Aliev, F., Latendresse, S.J., Hickman, M., Heron, J., Macleod, J., Joinson, C., Maughan, B., Lewis, G., & Kendler, K.S. (2013). Adolescent alcohol use is predicted by childhood temperament factors before age 5, with mediation through personality and peers. *Alcohol Clin Exp Res, 37*:2108-2117.

Grenard, J.L., Dent, C.W., & Stacy, A.W. (2013). Exposure to alcohol advertisements and teenage alcohol-related problems. *Pediatrics, 131*:e369-379.

Harper, K.M., Knapp, D.J., Breese, G.R. (2015). Withdrawal from chronic alcohol induces a unique CCL2 mRNA increase in adolescent but not adult brain-relationship to blood alcohol levels and seizures. *Alcohol Clin Exp Res, 39*(12):2375-85.

Hingson, R.W. & Zha, W. (2009). Age of drinking onset, alcohol use disorders, frequent heavy drinking, and unintentionally injuring oneself and others after drinking. *Pediatrics, 123*:1477-1484.

Holstein, S.E., Spanos, M., & Hodge, C.W. (2011). Adolescent C57BL/6J mice show elevated alcohol intake, but reduced taste aversion, as compared to adult mice: a potential behavioral mechanism for binge drinking. *Alcohol Clin Exp Res, 35*(10):1842-51.

Karkhanis, A.N., Alexander, N.J., McCool, B.A., Weiner, J.L., & Jones, S.R. (2015). Chronic social isolation during adolescence augments catecholamine response to acute ethanol in the basolateral amygdala. *Synapse, 69*:385-395.

Karkhanis, A.N., Locke, J.L., McCool, B.A., Weiner, J.L., & Jones, S.R. (2014). Social isolation rearing increases nucleus accumbens dopamine and norepinephrine responses to acute ethanol in adulthood. *Alcohol Clin Exp Res,* 38:2770-2779.

Keyes, K.M., Grant, B.F., & Hasin, D.S. (2008). Evidence for a closing gender gap in alcohol use, abuse, and dependence in the United States population. *Drug and Alcohol Dependence, 93*:21-29.

Kuhn, C. (2015). Emergence of sex differences in the development of substance use and abuse during adolescence. *Pharmacol Ther, 153*:55-78.

Lansford, J.E., Killeya-Jones, L.A., Miller, S,. & Costanzo, P.R. (2009). Early adolescents' social standing in peer groups: behavioral correlates of stability and change. *Journal of Youth & Adolescence, 38*:1084-1095.

Little, P.J., Kuhn, C.M., Wilson, W.A., & Swartzwelder, H.S. (1996). Differential effects of ethanol in adolescent and adult rats. *Alcohol Clin Exp Res, 20*(8), 1346-1351.

Markwiese, B.J., Acheson, S.K., Levin, E.D., Wilson, W.A., & Swartzwelder, H.S. (1998). Differential effects of ethanol on memory in adolescent and adult rats. *Alcohol Clin Exp Res, 22*:416-421.

Martinez, J.A., Sher, K.J., Wood, & P.K. (2014). Drinking consequences and subsequent drinking in college students over 4 years. *Psychology of Addictive Behaviors: Journal of the Society of Psychologists in Addictive Behaviors, 28*:1240-1245.

Monti, P.M., Miranda, R., Jr., Nixon, K., Sher. K.J., Swartzwelder, H.S., Tapert, S.F., White, A., & Crews, F.T. (2005). Adolescence: booze, brains, and behavior. *Alcohol Clin Exp Res, 29*:207-220.

Mundt, M.P., Zakletskaia, L.I., Brown, D.D., & Fleming, M.F. (2012). Alcohol-induced memory blackouts as an indicator of injury risk among college drinkers. *Inj Prev, 18*:44-49.

Rezvani, A.H. & Levin, E.D (2004). Adolescent and adult rats respond differently to nicotine and alcohol: motor activity and body temperature. *Int J Dev Neurosci, 22*:349-354.

Schramm-Sapyta, N.L., DiFeliceantonio, A.G., Foscue, E., Glowacz, S., Haseeb, N., Wang, N., Zhou, C., & Kuhn, C.M. (2010). Aversive effects of ethanol in adolescent versus adult rats: potential causes and implication for future drinking. *Alcohol Clin Exp Res, 34*:2061-2069.

Schramm-Sapyta, N.L., Kingsley, M.A., Rezvani, A.H., Propst, K., Swartzwelder, H.S., & Kuhn, C.M. (2008). Early ethanol consumption predicts relapse-like behavior in adolescent male rats. *Alcohol Clin Exp Res, 32*:754-762.

Schramm-Sapyta, N.L., Walker, Q.D., Caster, J.M., Levin, E.D., & Kuhn, C.M. (2009). Are adolescents more vulnerable to drug addiction than adults? Evidence from animal models. *Psychopharmacology (Berl), 206*(1):1-21.

Shadur, J.M., Hussong, A.M., & Haroon, M. (2015). Negative affect variability and adolescent self-medication: the role of the peer context. *Drug Alcohol Rev, 34*(6):571-80.

Skelly, M.J., Chappell, A.E., Carter, E., & Weiner, J.L. (2015). Adolescent social isolation increases anxiety-like behavior and ethanol intake and impairs fear extinction in adulthood: possible role of disrupted noradrenergic signaling. *Neuropharmacology, 97*:149-159.

Spanos, M., Besheer, J., & Hodge, C.W. (2012). Increased sensitivity to alcohol induced changes in ERK Map kinase phosphorylation and memory disruption in adolescent as compared to adult C57BL/6J mice. *Behav Brain Res, 230*(1):158-66.

Stevenson, R.A., Besheer, J., & Hodge, C.W. (2008). Comparison of ethanol locomotor sensitization in adolescent and adult DBA/2J mice. *Psychopharmacology (Berl), 197*(3):361-70.

Vargas, W.M., Bengston, L., Gilpin, N.W., Whitcomb, B.W., & Richardson, H.N. (2014). Alcohol binge drinking during adolescence or dependence during adulthood reduces prefrontal myelin in male rats. *J Neurosci, 34*:14777-14782.

Varlinskaya, E.I. & Spear, L.P. (2015). Social consequences of ethanol: Impact of age, stress, and prior history of ethanol exposure. *Physiology & Behavior, 148*:145-150.

White, A. & Hingson, R. (2013). The burden of alcohol use: excessive alcohol consumption and related consequences among college students. *Alcohol Res, 35*:201-218.

White, A.M., Ghia, A.J., Levin, E.D., & Swartzwelder, H.S. (2000).Binge pattern ethanol exposure in adolescent and adult rats: differential impact on subsequent responsiveness to ethanol. *Alcohol Clin Exp Res, 24*:1251-1256.

White, A.M., Jamieson-Drake, D.W., & Swartzwelder, H.S. (2002). Prevalence and correlates of alcohol-induced blackouts among college students: results of an e-mail survey. *J Am Coll Health, 51*:117-119, 122-131.

White, A.M., Signer, M.L., Kraus, C.L., & Swartzwelder, H.S. (2004). Experiential aspects of alcohol-induced blackouts among college students. *Am J Drug Alcohol Abuse, 30*:205-224.

White, A.M. & Swartzwelder, H.S. (2004). Hippocampal function during adolescence: a unique target of ethanol effects. *Ann N Y Acad Sci, 1021*:206-220.

White, A.M. & Swartzwelder, H.S. (2005). Age-related effects of alcohol on memory and memory-related brain function in adolescents and adults. *Recent Dev Alcohol, 17*:161-176.

Wills, T.A., Knapp, D.J., Overstreet, D.H., & Breese, G.R. (2010). Interactions of stress and CRF in ethanol-withdrawal induced anxiety in adolescent and adult rats. *Alcohol Clin Exp Res, 34*(9):1603-12.

Wills, T.A., Knapp, D.J., Overstreet, D.H., & Breese, G.R. (2008), Differential dietary ethanol intake and blood ethanol levels in adolescent and adult rats: effects on anxiety-like behavior and seizure thresholds. *Alcohol Clin Exp Res, 32*:1350-1360.

Wills, T.A., Knapp, D.J., Overstreet, D.H., & Breese, G.R. (2009). Sensitization, duration, and pharmacological blockade of anxiety-like behavior following repeated ethanol withdrawal in adolescent and adult rats. *Alcohol Clin Exp Res, 33*:455-463.

Windle, M., Spear, L.P., Fuligni, A.J., Angold, A., Brown, J.D., Pine, D., Smith, G.T., Giedd, J., Dahl, R.E. (2008). Transitions into underage and problem drinking: developmental processes and mechanisms between 10 and 15 years of age. *Pediatrics, 121 Suppl 4*:S273-289.

Yan, H., Li, Q., Madison, R., Wilson, W.A., & Swartzwelder, H.S. (2010). Differential sensitivity of hippocampal interneurons to ethanol in adolescent and adult rats. *J Pharmacol Exp Ther, 335*:51-60.

LONG-LASTING EFFECTS OF ALCOHOL IN ADOLESCENCE

Acheson, S.K., Bearison, C., Risher, M.L., Abdelwahab, S.H., Wilson, W.A., & Swartzwelder, H.S. (2013). Effects of acute or chronic ethanol exposure during adolescence on behavioral inhibition and efficiency in a modified water maze task. *PLoS One, 8*(10), e77768.

Alaux-Cantin, S., Warnault, V., Legastelois, R., Botia, B., Pierrefiche, O., Vilpoux, C., & Naassila, M. (2013). Alcohol intoxications during adolescence increase motivation for alcohol in adult rats and induce neuroadaptations in the nucleus accumbens. *Neuropharmacology, 67*, 521-531.

Allen, C.D., Rivier, C.L., & Lee, S.Y. (2011). Adolescent alcohol exposure alters the central brain circuits known to regulate the stress response. *Neuroscience, 182*, 162-168.

Boutros, N., Semenova, S., Liu, W., Crews, F.T., & Markou, A. (2015). Adolescent intermittent ethanol exposure is associated with increased risky choice and decreased dopaminergic and cholinergic neuron markers in adult rats. *Int J Neuropsychopharmacol, 18*(2).

Broadwater, M.A., Liu, W., Crews, F.T., & Spear, L.P. (2014). Persistent loss of hippocampal neurogenesis and increased cell death following adolescent, but not adult, chronic ethanol exposure. *Dev Neurosci, 36*(3-4), 297-305.

Cohen, J.R., Asarnow, R.F., Sabb, F.W., Bilder, R.M., Bookheimer, S.Y., Knowlton, B.J., & Poldrack, R.A. (2010). A unique adolescent response to reward prediction errors. *Nat Neurosci, 13*(6), 669-671.

Coleman, L.G., Jr., He, J., Lee, J., Styner, M., & Crews, F.T. (2011). Adolescent binge drinking alters adult brain neurotransmitter gene expression, behavior, brain regional volumes, and neurochemistry in mice. *Alcohol Clin Exp Res, 35*(4), 671-688.

Coleman, L.G., Jr., Liu, W., Oguz, I., Styner, M., & Crews, F.T. (2014). Adolescent binge ethanol treatment alters adult brain regional volumes, cortical extracellular matrix protein and behavioral flexibility. *Pharmacol Biochem Behav, 116*, 142-151.

Crews, F.T., He, J., & Hodge, C. (2007). Adolescent cortical development: a critical period of vulnerability for addiction. *Pharmacol Biochem Behav, 86*(2), 189-199.

Crews, F.T. (2008). Alcohol-related neurodegeneration and recovery: mechanisms from animal models. *Alcohol Res Health, 31*(4), 377-388.

Crews, F.T. & Vetreno, R.P. (2011). Addiction, adolescence, and innate immune gene induction. *Front Psychiatry, 2*, 19.

Crews, F.T. & Vetreno, R.P. (2014). Neuroimmune basis of alcoholic brain damage. *Int Rev Neurobiol, 118*, 315-357.

Ehlers, C.L., Criado, J.R., Wills, D.N., Liu, W., & Crews, F.T. (2011). Periadolescent ethanol exposure reduces adult forebrain ChAT+IR neurons: correlation with behavioral pathology. *Neuroscience, 199*, 333-345.

Ehlers, C.L., Liu, W., Wills, D.N., & Crews, F.T. (2013). Periadolescent ethanol vapor exposure persistently reduces measures of hippocampal neurogenesis that are associated with behavioral outcomes in adulthood. *Neuroscience, 244*, 1-15.

Ehlers, C.L., Oguz, I., Budin, F., Wills, D.N., & Crews, F.T. (2013). Peri-adolescent ethanol vapor exposure produces reductions in hippocampal volume that are correlated with deficits in prepulse inhibition of the startle. *Alcohol Clin Exp Res, 37*(9), 1466-1475.

Fleming, R.L., Acheson, S.K., Moore, S.D., Wilson, W.A., & Swartzwelder, H.S. (2012). In the rat, chronic intermittent ethanol exposure during adolescence alters the ethanol sensitivity of tonic inhibition in adulthood. *Alcohol Clin Exp Res, 36*:279-285.

Gass, J.T., Glen, W.B., Jr., McGonigal, J.T., Trantham-Davidson, H., Lopez, M.F., Randall, P.K., Yaxley, R., Floresco, S.B., Chandler, L.J. (2014). Adolescent alcohol exposure reduces behavioral flexibility, promotes disinhibition, and increases resistance to extinction of ethanol self-administration in adulthood. *Neuropsychopharmacology, 39*(11), 2570-2583.

Gilpin, N.W., Karanikas, C.A., & Richardson, H.N. (2012). Adolescent binge drinking leads to changes in alcohol drinking, anxiety, and amygdalar corticotropin releasing factor cells in adulthood in male rats. *PLoS One, 7*(2), e31466.

Liu, W., Crews, F.T. (2015). Adolescent intermittent ethanol exposure enhances ethanol activation of the nucleus accumbens while blunting the prefrontal cortex responses in adult rat. *Neuroscience, 293*:92-108.

Maldonado-Devincci, A.M., Alipour, K.K., Michael, L.A., & Kirstein, C.L. (2010). Repeated binge ethanol administration during adolescence enhances voluntary sweetened ethanol intake in young adulthood in male and female rats. *Pharmacol Biochem Behav, 96*(4), 476-487.

Milivojevic, V. & Covault, J. (2013). Alcohol exposure during late adolescence increases drinking in adult Wistar rats, an effect that is not reduced by finasteride. *Alcohol Alcohol, 48*(1), 28-38.

Nagel, B.J., Schweinsburg, A.D., Phan, V., & Tapert, S.F. (2005). Reduced hippocampal volume among adolescents with alcohol use disorders without psychiatric comorbidity. *Psychiatry Res, 139*(3), 181-190.

Qin, L., Liu, Y., Hong, J.S., & Crews, F.T. (2013). NADPH oxidase and aging drive microglial activation, oxidative stress, and dopaminergic neurodegeneration following systemic LPS administration. *Glia, 61*(6), 855-868.

Pandey, S.C., Sakharkar, A.J., Tang, L., & Zhang, H. (2015). Potential role of adolescent alcohol exposure-induced amygdaloid histone modifications in anxiety and alcohol intake during adulthood. *Neurobiol Dis, 82*, 607-619.

Pascual, M., Boix, J., Felipo, V., & Guerri, C. (2009). Repeated alcohol administration during adolescence causes changes in the mesolimbic dopaminergic and glutamatergic systems and promotes alcohol intake in the adult rat. *J Neurochem, 108*(4), 920-931.

Risher, M.L., Fleming, R.L., Boutros, N., Semenova, S., Wilson, W.A., Levin, E.D., Markou, A., Swartzwelder, H.S., & Acheson, S.K. (2013). Long-term effects of chronic intermittent ethanol exposure in adolescent and adult rats: radial-arm maze performance and operant food reinforced responding. *PLoS One, 8*:e62940.

Risher, M.L., Fleming, R.L., Risher, W.C., Miller, K.M., Klein, R.C., Wills, T., Acheson, S.K., Moore, S.D., Wilson, W.A., Eroglu. C., & Swartzwelder, H.S. (2015). Adolescent intermittent alcohol exposure: persistence of structural and functional hippocampal abnormalities into adulthood. *Alcohol Clin Exp Res, 39*:989-997.

Risher, M.L., Sexton, H.G., Risher, W.C., Wilson, W.A., Fleming, R.L., Madison, R.D., Moore, S.D., Eroglu, C., & Swartzwelder, H.S. (2015). Adolescent intermittent alcohol exposure: dysregulation of thrombospondins and synapse formation are associated with decreased neuronal density in the adult hippocampus. *Alcohol Clin Exp Res, 39*(12):2403-13.

Shnitko, T.A., Spear, L.P., & Robinson, D.L. (2016). Adolescent binge-like alcohol alters sensitivity to acute alcohol effects on dopamine release in the nucleus accumbens of adult rats. *Psychopharmacology (Berl), 233*(3):361-371.

Spear, L. (2000). Modeling adolescent development and alcohol use in animals. *Alcohol Res Health, 24*(2), 115-123.

Spear, L.P. & Swartzwelder, H.S. (2014). Adolescent alcohol exposure and persistence of adolescent-typical phenotypes into adulthood: a mini-review. *Neurosci Biobehav Rev, 45*, 1-8.

Spear, L.P. & Varlinskaya, E.I. (2005). Adolescence. Alcohol sensitivity, tolerance, and intake. *Recent Dev Alcohol, 17*, 143-159.

Swartzwelder, H.S., Acheson, S.K., Miller, K.M., Sexton, H.G., Liu, W., Crews, F.T., & Risher, M.L. (2015). Adolescent intermittent alcohol exposure: deficits in object recognition, memory and forebrain cholinergic markers. *PLoS One, 10*(11), e0140042.

Taffe, M.A., Kotzebue, R.W., Crean, R.D., Crawford, E.F., Edwards, S., & Mandyam, C.D. (2010). Long-lasting reduction in hippocampal neurogenesis by alcohol consumption in adolescent nonhuman primates. *Proc Natl Acad Sci USA, 107*(24), 11104-11109.

Varlinskaya, E.I. & Spear, L.P. (2015). Social consequences of ethanol: impact of age, stress, and prior history of ethanol exposure. *Physiol Behav, 148*, 145-150.

Vetreno, R.P., Broadwater, M., Liu, W., Spear, L.P., & Crews, F.T. (2014). Adolescent, but not adult, binge ethanol exposure leads to persistent global reductions of choline acetyltransferase expressing neurons in brain. *PLoS One, 9*(11), e113421.

Vetreno, R.P., Crews, F.T. (2015). Binge ethanol exposure during adolescence leads to a persistent loss of neurogenesis in the dorsal and ventral hippocampus that is associated with impaired adult cognitive functioning. *Front Neurosci, 9*:35.

Vetreno, R.P., Yaxley, R., Paniagua, B., Crews, F.T. (2015). Diffusion tensor imaging reveals adolescent binge ethanol-induced brain structural integrity alterations in adult rats that correlate with behavioral dysfunction. *Addict Biol.*

Windle, M., Spear, L.P., Fuligni, A.J., Angold, A., Brown, J.D., Pine, D., & Dahl, R.E. (2008). Transitions into underage and problem drinking: developmental processes and mechanisms between 10 and 15 years of age. *Pediatrics, 121 Suppl 4*, S273-289.

EFFECTS OF PARENTS

Blustein, E.C., Munn-Chernoff, M.A., Grant, J.D., Sartor, C.E., Waldron, M., Bucholz, K.K., Madden, P.A., & Heath, A.C. (2015). The association of low parental monitoring with early substance use in european American and African American adolescent girls. *J Stud Alcohol Drugs, 76*(6):852-61.

Clark, D.B., Cornelius, J.R., Kirisci, L., & Tarter, R.E. (2005). Childhood risk categories for adolescent substance involvement: a general liability typology. *Drug and Alcohol Dependence, 77*:13-21.

Foley, K.L., Altman, D., Durant, R.H., & Wolfson, M. (2004). Adults' approval and adolescents' alcohol use. *J Adolesc Health, 35*:345 e317-326.

Jackson, C. (2002). Perceived legitimacy of parental authority and tobacco and alcohol use during early adolescence. *J Adolesc Health, 31*:425-432.

Jackson, C., Henriksen, L., & Dickinson, D. (1999). Alcohol-specific socialization, parenting behaviors and alcohol use by children. *J Stud Alcohol, 60*:362-367.

Jones, D.J., Hussong, A.M., Manning, J., & Sterrett, E. (2008). Adolescent alcohol use in context: the role of parents and peers among African American and European American youth. *Cultur Divers Ethnic Minor Psychol, 14*:266-273.

Kaynak, O., Winters, K.C., Cacciola, J., Kirby, K.C., & Arria, A.M. (2014). Providing alcohol for underage youth: what messages should we be sending parents? *Journal of Studies on Alcohol and Drugs, 75*:590-605.

LaBrie, J.W., Boyle, S.C., & Napper, L.E. (2015). Alcohol abstinence or harm-reduction? Parental messages for college-bound light drinkers. *Addict Behav, 46*:10-13.

Lynch, A.D., Coley, R.L., Sims, J., Lombardi, C.M., & Mahalik, J.R. (2015). Direct and interactive effects of parent, friend and schoolmate drinking on alcohol use trajectories. *Psychol Health, 30*:1183-1205.

Reimuller, A., Hussong, A., & Ennett, S.T. (2011). The influence of alcohol-specific communication on adolescent alcohol use and alcohol-related consequences. *Prev Sci, 12*:389-400.

Ryan, S.M., Jorm, A.F., Kelly, C.M., Hart, L.M., Morgan, A.J., & Lubman, D.I. (2011). Parenting strategies for reducing adolescent alcohol use: a Delphi consensus study. *BMC Public Health, 11*:13.

Ryan, S.M., Jorm, A.F., & Lubman, D.I. (2010). Parenting factors associated with reduced adolescent alcohol use: a systematic review of longitudinal studies. *Aust NZJ Psychiatry, 44*:774-783.

Song, E.Y., Smiler, A.P., Wagoner, K.G., & Wolfson, M, (2012). Everyone says it's ok: adolescents' perceptions of peer, parent, and community alcohol norms, alcohol consumption, and alcohol-related consequences. *Subst Use Misuse, 47*:86-98.

Stogner, J.M. & Gibson, C.L. (2016). Genetic modification of the relationship between parental rejection and adolescent alcohol use. *Alcohol Alcohol, pii*: agv136.

Varvil-Weld, L., Crowley, D.M., Turrisi, R., Greenberg, M.T., & Mallett, K.A. (2014). Hurting, helping, or neutral? The effects of parental permissiveness toward adolescent drinking on college student alcohol use and problems. *Prev Sci, 15*:716-724.