

INNOVATE EVIDENCE-BASED MENTAL HEALTH RESEARCH



The Adolescent Brain and Substances

Adolescence is a vulnerable period marked by complex social, biological, and psychological changes. What happens in the brain when substances are introduced during this critical period of rapid development? Dr. Amanda Guyer studies how substances may alter connections in the brain and change how youth think and behave.

Public Health Concern

Adolescent substance use is a public health concern. Almost a quarter of 18-25 year olds report some experimentation with illicit substances. Estimates indicate 20-30% of adolescents have used alcohol or drugs by 9th grade and 50-70% by 12th grade. (Johnson et al. 2014 Monitoring the Future national survey)

From early adolescence to young

adulthood, the brain is still developing and neurons are continuing to connect. In order to develop prevention and educational approaches to reducing adolescent substance use, researchers must understand the developmental, environmental and psychosocial factors that contribute to the prevalence of adolescent substance use.

Collecting Time Points

Amanda Guyer, Associate Professor at the Center for Mind and Brain and a UC Davis Chancellor's fellow, was selected for one of the Behavioral Health Center of Excellence 23 Pilot Award Grants for the study, "Charting the Gateway Years: Linking Brain Connectivity Trajectories and Psychosocial Risk Profiles with Substance Use from Early Adolescence into Young Adulthood."

Guyer praised the Pilot Award as being timely for her research. "When you are doing developmental research

and you have an ascertained sample you are trying to track people as they grow and change. This award has facilitated an opportunity to maintain scientific integrity of assessing the same people at an important age." With a longitudinal experiment that measures change over many time points correlational conclusions can be made about what came first.

This study works with a sample of youth initially recruited through a William T. Grant Scholars Award. All participants are Mexican-origin youth who began the study at age 10 with home interviews to evaluate their home lives and risk for substance use. By following the same group of individuals over time Guyer can address the question of whether brain function is a susceptibility factor for developing substance use in adolescence.

“This work has important implications for the youth involved and for society at large. Substance abuse leads to a myriad of mental health and social problems. Understanding cause and effect as it plays out in the maturing adolescent brain will open up new avenues for prevention.”

*-Cameron Carter, M.D.,
Director, Behavioral Health Center of Excellence at UC Davis*

Reward-Control Connections

A related study showed earlier onset of adolescent substance use predicts stronger connectivity between reward and cognitive control brain networks (Weissman, D.G., et al., 2015). We know that an area of the brain called the nucleus accumbens (NAcc) is involved in processing rewards and involved in addiction. Similarly, the pre-frontal cortex (PFC) is involved in controlling behavior and cognitive control. These two areas were recently found to be linked more strongly depending on how old subjects were when they began using substances; the younger the age of onset, the tighter the coupling between reward and control regions.

As we mature, our brains become more specialized and links become more defined. If the pre-frontal cortex and nucleus accumbens are so tightly linked, their roles may become muddled and the control region (PFC) may have to regulate more. The intake of substances may thwart resource allocation and inhibit what normally occurs during development.

Guyer’s study uses neuroscience tools to understand how the brain responds to cues in the world. fMRI is a tool used to monitor brain activity and map

engaged areas of the brain and their interconnectivity as parts of larger networks. In studying the relationship between the PFC, which allows us to evaluate future consequences, and the NAcc, which processes reward and value, there is the potential to identify biomarkers that regulate substance use behaviors that may lead to later abuse.

Understanding Early Substance Abuse

Substance use has an immediate impact on physiology. By identifying risk factors that lead to earlier substance use, researchers may be able to help youth at risk for developing more severe substance abuse problems in the future. “Early drug use is associated with and predicts later psychiatric disorders.” (Brook et al., 2002) Guyer’s study works to understand relationships between biological and psychosocial factors that contribute to this association over time.

Guyer’s study also works towards incorporating variations in environment such as parenting, socioeconomic status, and social factors to better identify who is at risk for substance abuse. This allows the team a better understanding of whether the brain starts to react differently, which in turn leads to certain behaviors, or if some behaviors alter the brain’s

ability to respond appropriately. “For example, when someone is developing depression and is sleeping more and not as engaged in the world; is that altering brain function? Or is an altered brain function leading to these actions?” explained Guyer.

Research as a Resource

Guyer identified the need to link mental health practitioners with researchers who are studying at-risk populations. Because practitioners see mental health issues on a daily basis, Guyer would like to be a resource and identify problems that can be addressed by research. The Behavioral Health Center of Excellence works to solidify the connection between research and mental health needs through publications, symposia and lectures.

1. Johnston L. D., O’Malley P. M., Miech R. A., Bachman J. G., Schulenberg J. E. (2014). Monitoring the Future national survey results on drug use: 1975-2013: Overview, key findings on adolescent drug use. Ann Arbor: Institute for Social Research, The University of Michigan
2. Weissman, D.G., et al., Earlier adolescent substance use onset predicts stronger connectivity between reward and cognitive control brain networks. Dev. Cogn. Neurosci. (2015), <http://dx.doi.org/10.1016/j.dcn.2015.07.002>

Behavioral Health Center of Excellence at UC Davis

UC Davis launched the Behavioral Health Center of Excellence in October 2014 to advance mental health research and policy with initial funding from the Mental Health Services Act. The Innovate series highlights the Center’s \$4.3 million Research Pilot Award program.

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